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COASTAL ZONE MANAGEMENT IN TUNISIA:  
TOWARDS AN ACTION PLAN FOR THE FUTURE

by

AYARI FAOUZI

TUNISIA

A paper submitted to the Faculty of the World Maritime University in  
partial fulfilment of the requirements for the award of a

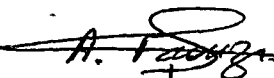
MASTER OF SCIENCE DEGREE

in

GENERAL MARITIME ADMINISTRATION

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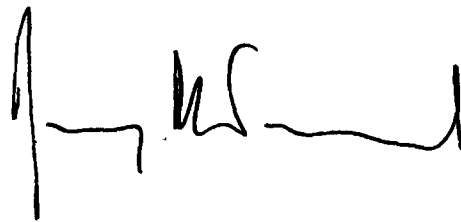
  
Date : 24 October 1990

Supervised and assessed by:

Dr. J. Mlynarczyk  
Professor, World Maritime University

Co-assessed by:

Dr. E. Gold  
Professor of Maritime Law, and  
Professor of Resource and Environmental Studies  
Dalhousie University  
Halifax, N.S., Canada



## DEDICATION

I dedicate this work to my country.  
And to my mother and my father,  
and my grandparents, whose moral  
support and encouragement during  
these two years has been invaluable.

Ayari Faouzi



## ABSTRACT

### TUNISIA'S COASTAL ZONE: TOWARDS AN ACTION PLAN FOR THE FUTURE

Coastal zone resources management is a vast subject, encompassing a variety of both physical and economic activities, all of which take place in a very sensitive and delicate area where the atmosphere, hydrosphere and lithosphere interface.

To claim to discuss and deal with all these conflicting - but inter-related - aspects would be a pretentious task beyond the scope and purposes of this paper.

The objective here is: to try to discuss the way these physical and economic factors interact in the coastal zone (with particular reference to the Tunisian case); to discuss their potential risks to the marine environment and often fragile coastal ecosystems; and finally to stress the need for rational planning and an efficient regulatory system in order to foster sustainable development.

However, the slow and sometimes intricate bureaucracy in the country and the complex organizational behaviour within the Tunisian institutional infrastructure have not made this task easy to achieve and have delayed the optimal development of the coastal zone resources and the protection of the marine environment and the coastal ecosystem.

Therefore my recommendation is the promulgation of a Coastal Zone Management Programme and the establishment of a leading agency which will have an overall responsibility for the execution of the Programme on the one hand, and coordination of the policies and activities amongst the multiple national agencies with responsibility for one or more sectors in the coastal zone, on the other hand.

Finally, I should add that no matter how strong and comprehensive the management programme and no matter how efficient and well structured the organizational infrastructure, effective coastal zone management in the country will not succeed and defined goals will not be attained, without the understanding, the acceptance and the cooperation of the people who are directly affected by it.

## ACKNOWLEDGMENTS

This paper would not have been possible without the help, advice and encouragement of friends and colleagues, for which I am sincerely grateful.

First and foremost I wish to express my gratitude to my Course Professor Dr. J. Mlynarczyk for his inestimable support throughout two years of study at WMU and for giving me the opportunity, under his guidance, to undertake this project on the subject of Coastal Zone Management in Tunisia. Moreover, I wish to thank him for making it possible for me to undertake my job training in Canada, one of the leading countries in coastal zone management and environmental matters. It was a crucial opportunity for me to gather invaluable data and materials for this project, which will no doubt also be of great value to me in my future work in Tunisia.

I am especially indebted to Dr. Edgar Gold, Executive Director of the Oceans Institute of Canada and Professor of Maritime Law and of Resource and Environmental Studies at Dalhousie University for his role in facilitating my job training in Halifax, and for his highly valued guidance and encouragement, and that of his colleagues, during my stay in Canada.

I wish to express appreciation to the Ministry of Transport of Tunisia, and particularly the Director-General of Merchant Marine for making it possible for me to enhance my knowledge and expertise during these two years at WMU, and to the Federal Republic of Germany for financing my studies.

Finally, I would like to acknowledge the crucial role played by host governments and organizations in the field study programme, and to the Visiting Professors and Resident Faculty for their contributions to the programme of studies at WMU.

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## CHAPTER ONE

### TUNISIA'S COASTAL ZONE AND ITS RESOURCES: PHYSICAL ASPECTS

This chapter will comprise a brief presentation of the general physical and geomorphological aspects of the Tunisian coastal zone. Although the main purpose is to discuss issues related to policy-making, planning and management of the coastal zone and its resources, I believe that a broad idea about the physical features and the particular characteristics of the coastal area will be very useful for the reader so that he will be able to objectively assess the potential, and the limitations as well, of the Tunisian coastal zone and its resources.

#### I. WHAT IS THE COASTAL ZONE?

##### I.1 Definition of the coastal zone: Physical features

The use of physical features to define the coastal zone is a commonly used criteria and most importantly has the advantage of being simple to describe and easy to understand. However, the use of the continental shelf - which encompasses most economically significant marine resources, such as fisheries and offshore oil and gas - as the seaward boundary of the coastal zone needs a precisely chartable edge and this depends on the work done by local and international hydrographic surveys.

The coastal zone is located at the interface between the two major environments: the land and the ocean. It has been defined as that part of the ocean affected by the land and that part of the land affected by the ocean. The two environments meet at the shoreline, which is constantly changing. In the seaward direction, certainly part, if not all, of the continental shelf should be included within the coastal zone. It is important in this respect, however, to mention that Tunisia has the widest and most extensive continental shelf in the entire Mediterranean Sea, particularly off its eastern coast. In the landward direction the coastal zone includes estuaries, marshes, lagoons and bays which exceed an area of 350,000 acres. It also includes sea cliffs, deltas and coastal plains, and other similar environments. The shoreline and the

nearshore waters - that area seaward of the shoreline - are very dynamic areas which on a nationwide basis, have a length of over 1,400 km.

#### I.1.1 The coastline: geophysical aspects

There is a sharp contrast between the physical characteristics of Tunisia's northern and eastern coasts. The northern coast, from the Algerian border to the Cap Bon Peninsula, faces the western Mediterranean and has a rather narrow continental shelf, generally less than 10 km wide. The annual average rainfall in this coastal region is high (approx. 600 mm) with frequent strong prevailing winds from a north-westerly direction, thus subjecting the shoreline to north-westerly swell. Storm waves several metres high are not uncommon during the winter. Longshore drifting runs from west to east. The tide is semidiurnal, with a small average range of about 0.2 m. The coastline truncates the highlands of the country (Kroumirie and Mogod mountains) and, because of the high energy littoral environment, rugged cliffs and bluffs cut principally in sand-stones, represent the main geomorphic features (Figure 1). Only short ephemeral streams reach the sea; and there is little sandy shoreline west of Tabarka. However, eroding cliffs, combined with strong winds and the dry summers typical of the region generate an abundant supply of sand which results in extensive mobile dunes (about 300 km<sup>2</sup>), showing evidence of south eastward movement and transgression over the hinterland topography.

The Gulf of Tunis is a transitional area between the northern and eastern coastlines. It is relatively protected from the north westerly swell by its north eastward orientation. It is characterized by embayments and long sandy beaches. The land area is of a more open continental topography with deltaic plains built by the only two perennial streams of Tunisia, both prone to heavy floods, the Miliane River and, especially, the Medjerda River.

The eastern coast, which extends from the Cap Bon peninsula to the Libyan border, relates to the eastern Mediterranean. Rainfall diminishes as we move south, and in the Gulf of Gabes semiarid conditions prevail, with average annual rainfall under 200 mm. The continental shelf in this area is the widest in the Mediterranean (more than 200 km wide at the

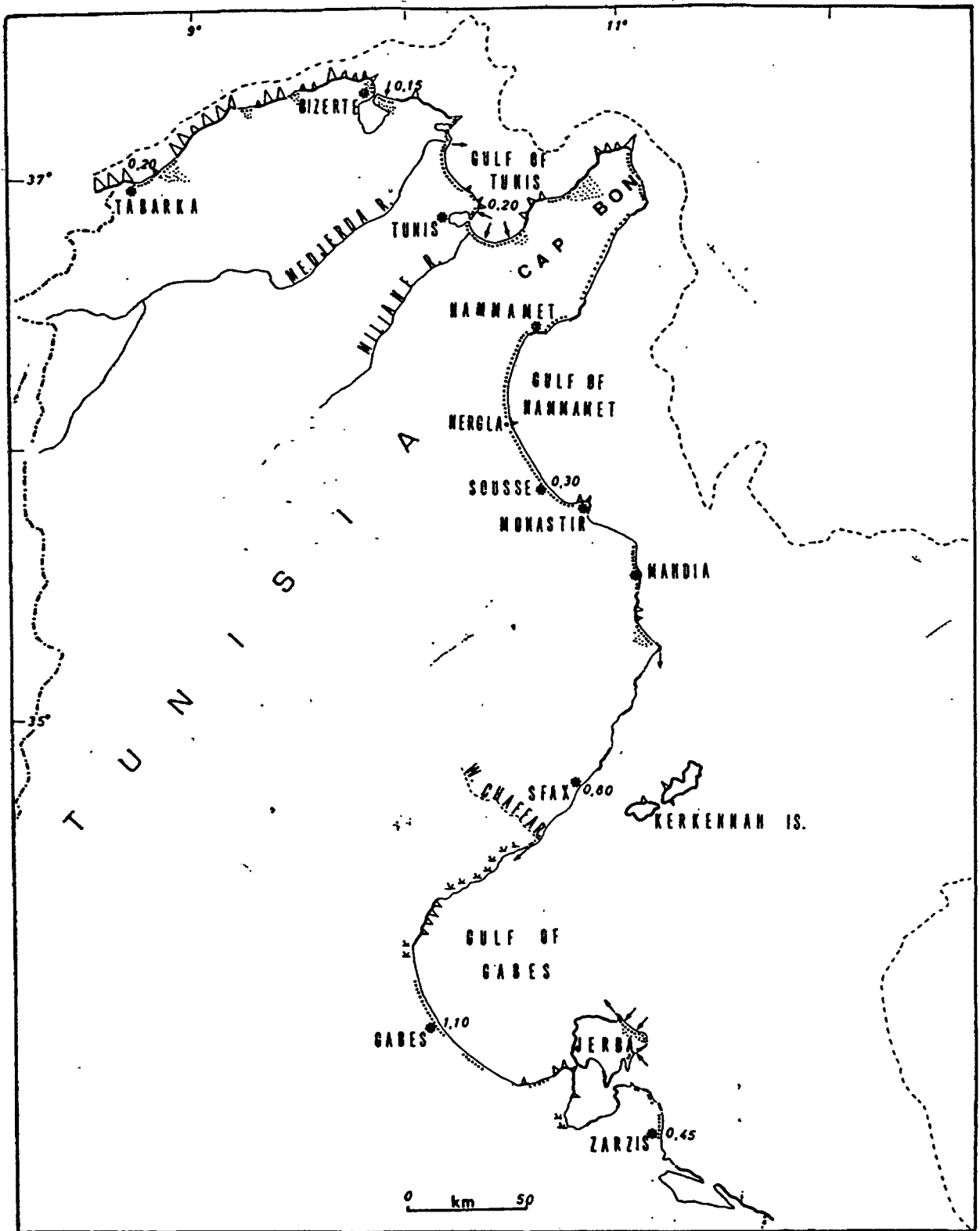













Figure 1: Predominant coastal landforms in Tunisia

- |   |                             |   |                             |
|---|-----------------------------|---|-----------------------------|
|  | Mean tide range             |  | Cliff (less than 15 m high) |
|  | Cliff (more than 15 m high) |  | Sandy shoreline             |
|  | Low rocky shoreline         |  | Salt marshes                |
|  | Silty shoreline             |  | Retreating beach            |
|  | Coastal dunes               |  | Prograding beach            |
|  | -200 m isobath              |   |                             |

latitude of the Kerkennah Islands). The coastline, which is characterized by low energy, is subjected to only local winds from between an easterly/northerly direction in spring and summer, and from the west in autumn and winter. Waves mainly come from the northeast, also from the southeast in the Gulf of Gabes, and generally die out before reaching the shore because of the shallowness of the wide continental shelf. Submarine meadows extending between -1m and -30m, also help diminish the wave energy and additionally increase sand deposition. The coastline between Sfax and Gabes has some additional protection from the Kerkennah Islands. However, during exceptional winter storms, like the one that occurred in January 1981, wave erosion may take place. Generally a weak longshore drifting goes southward. Tides, with a maximum range up to 1.8 m, are an important phenomena in the Gulf of Gabes. In the narrows surrounding Djerba and Kerkennah Islands, tidal currents up to 1 and 2 knots are particularly noticeable and have resulted in the excavation, in the shallow continental shelf, of meandering channels, known as submarine wadis.

A low energy marine environment, combined with subdued topography of the hinterland, have together produced the geomorphic features of Tunisia's eastern coast. The coast around the Gulf of Hammamet, in the vicinity of Mahdia and Gabes, in eastern Djerba, and near Zarzis, predominantly is comprised of sandy beaches. Cliffs are small and infrequent and in the areas of eastern Djerba and Zarzis, beachrock is occasionally found. It is thought that sand of the beaches fringing the Gulf of Gabes came from the sea floor; and there is presently no significant source of sand supply from wadis or eroding cliffs on this coast. Near Gabes, beaches are highly polluted by wastes from industrial plants erected during the last decade. Muddy tidal flats extend south of Sfax. The present coastal morphology of the Monastir area is characterized northward by retreating cliffs cut in soft rocks and eastward by a low rocky sandstone shore.

#### I.1.2 Major coastal ecosystems: Lagoons, deltas, and salt marshes

Tunisia is known for its coastal ecosystems with high biological yield such as coastal lagoons, lakes, deltas and salt marshes (see Annex 1). Such systems, halfway between land and sea, are transitional

littoral zones which are highly productive environments having particular vulnerability to the activities of man. These coastal environments are unique owing to the peculiar conditions of their hydrodynamics and sedimentation. They are places of active accumulation and provide shelter situations, the effects of which are noticeable in the geochemical properties and nature of the sediments and the vast potential wealth of biological resources.

Deltas are areas of quiet water with intermediate salinity. Sedimentation rates are high because of the material carried in by the rivers. Most deltas have resulted from the recent rise of sea level but this is not always the case. For instance, the present-day pattern of the Medjerda delta resulted from the cutting of a new outlet during a major flood in 1973. Deprived of sediment supply, the old delta has been eroded.

Estuaries, which form an integral part of the coastal zone, could be considered as that part of the river where tidal and river currents meet and mix. They have very specific characteristics which make them biologically unique, apart from also being environmentally and aesthetically very appealing areas.

Estuaries in the Gulfs of Tunis, Hammamet and Gabes are generally very rich in nutrients largely because the rivers that enter them, such as the Medjerda and Meliane rivers (the major systems of the country), carry waste products which are often nutrient-rich and actually of benefit to the environment. The nutrient supply supports a large population of phytoplankton and thus provides a major food supply for organisms further up in the food chain (such as zoo plankton, fish and shellfish). These estuaries are therefore areas of highest productivity, constituting the major habitat of many fish and other creatures which spend some portion of their lives in them.

Many of the estuaries of the Tunisian coastal area are bordered by a narrow vegetation or wetland area containing salt marshes. Salt marshes are generally located in intertidal areas, along the banks of tidal rivers, or behind barrier beaches. They are an extremely productive environment which supports a large marine population, including fish, birds, shellfish and plants. They also form a protective barrier for the



land behind them against the effects of storms and high seas. The addition of nutrients carried in by rivers combines to make marshes highly productive in organic matter; production can be as high as 5-10 tons per year of organic matter per acre compared to 1 ton per year per acre for a wheat field or less than 0.5 tons per year for the open ocean or for a desert. This large production of organic matter results in an excellent food supply which can be consumed by the myriad of organisms which inhabit the area, either for all or part of their lives.

As cities grow and the need for prime development areas increases, there are considerable pressures to develop wetlands and as a result marshes are slowly built over and developed. This was the case with the marsh located outside the old city of Tunis (the Medina), which no longer exists as the area was reclaimed and developed. This will be discussed further in Chapter Two: Resource Uses and Human Activities in the Coastal Area of Tunisia.

Marshes, which contain many food products, such as clams, oysters, scallops, and fish, of importance to the local economy, also have other important values. For example marshes can remove some pollutants from the water, in particular, nitrogen and some metals. Experiments are being conducted to see the effects of adding sewage to coastal marshes. In addition to removing the pollutants, an added benefit is that nutrients from the sewage increase the productivity of the marsh. The nutrients can be used by the plants and lead to their increased growth and thus to an increased source of food for other organisms in the food chain.

Lagoons, another component of the coastal zone, are somewhat similar to estuaries, being broad, shallow areas partly separated from the ocean by offshore barrier beaches. However, it should be remembered that estuaries and lagoons, like many other parts of the coastal area, are transient or temporary features, and in the course of time, they will be destroyed either by cutback of the coastline caused by marine erosion or by the build-up of marshes. As marshes grow, they tend to close up the seaward parts of the estuary. Estuaries also tend to fill up, not only with sediments carried by rivers entering them, but also with sediments from offshore areas. An example of this is Lake Kelbia which is situated

between Sousse and Kairouan. This lake can cover a surface area of approximately 27,000 acres after heavy precipitation and may reach a maximum depth of 4 metres. Production of fish in this lake averages 35 tons per year.

These areas offer a major habitat for a wide variety of fauna and are regions of the highest productivity. A great many amphihaline species, such as anadromous fishes which spawn in fresh water and catadromous fishes which spawn in the sea (sturgeon, eels, sea bream, bass, mullet, etc.), and crustacea and molluscs, spend some or most of their life cycle in these eutrophic coastal ecosystems. For these reasons, these coastal environments deserve special care to avoid the serious ecological consequences which would result from their impingement.

## I.2 Major natural hazards and risks

From the brief presentation above, it can be seen that the coastal zone constitutes a high energy zone with very active and complex dynamics and considerable instability. This instability is going to continue since the area is subject to natural evolution trends, and also to a wide variety of geological hazards.

Their effects, compounded by the activities of man, threaten both the present usage of the coastal zone and future expansion of its occupance. The coastal zone, exposed to attack by nature and man, constitutes an area of great vulnerability. Anarchic settlement and use has not enhanced chances of even a limited equilibrium.

Major hazards to which the Tunisian coastal zone is exposed include: coastal erosion, storms, floods, estuary destruction, and natural and man-made pollution. In the following two paragraphs I will discuss only the two major natural threats to the Tunisian coastal zone: erosion of the shoreline and eutrophication.

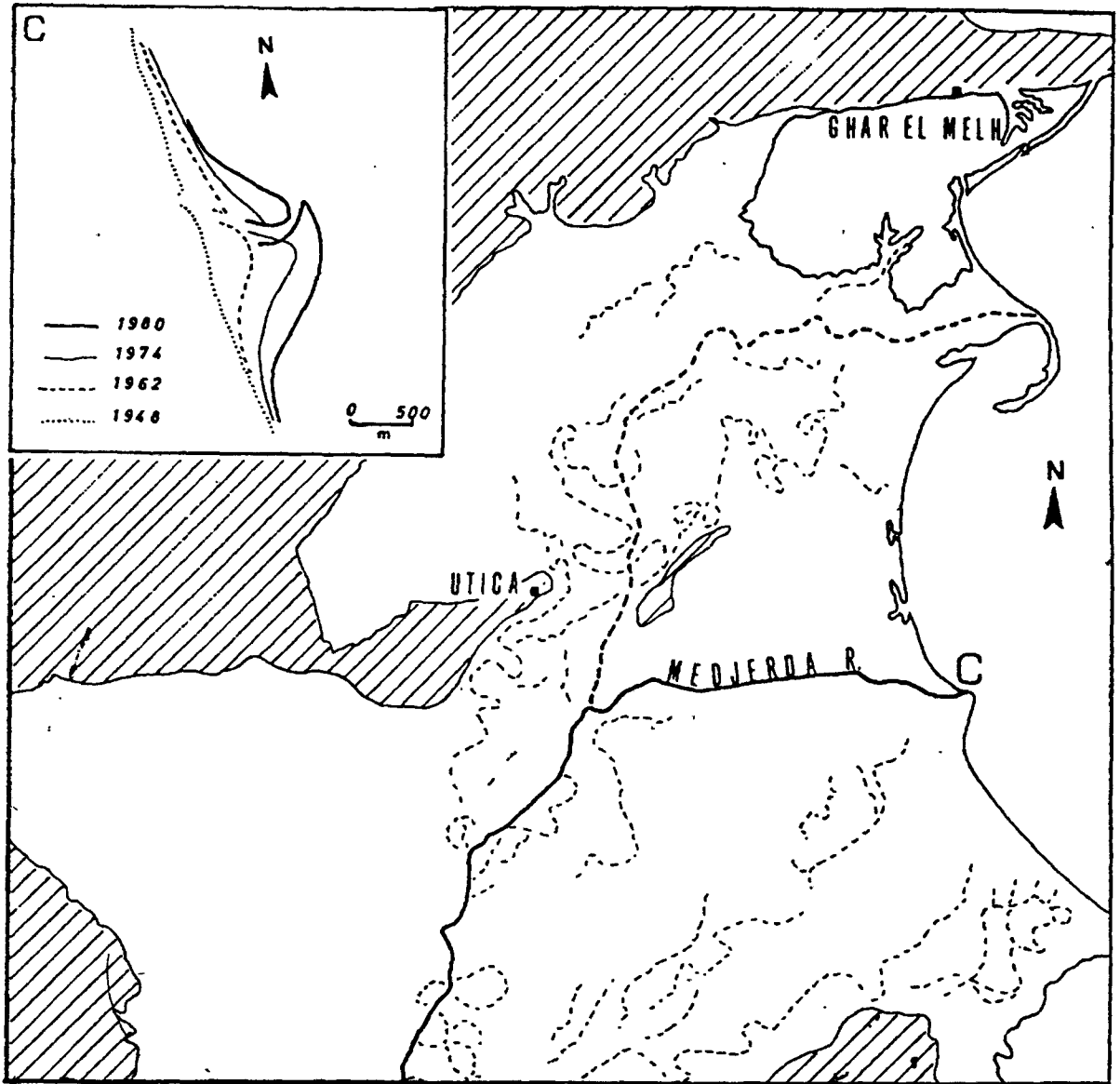
### I.2.1 Erosion and shoreline degradation

Almost the entire Tunisian coastline is currently eroded. This has been caused by a combination of wave action and a slight rise in the sea level during the historical period, which has caused the loss of numerous valuable coastal sites of archaeological interest, such as, for instance,

the ancient Punic Port of Carthage in the Gulf of Tunis. Beach erosion is a serious problem, particularly for a country like Tunisia where the tourist industry, predominantly based on the sea and beachside activities, has been a major priority of the authorities since 1960. In fact earnings from the tourist industry (totalling US\$ 1.2 billion in 1988) constitute the second source of foreign currency for the country. With the exception of a few restricted sectors of progradation (the mouth of the Medjerda River - shown in detail on Figure 2 - and three spits indicated on Figure 1), sandy shorelines are threatened by erosion. Rapidly eroding beaches are found in the surrounding region of Tunis and particularly at Djerba Island, both areas of importance to the tourist industry. Here the accretion taking place at the tip of Ras Rmel is the counterpart of the severe erosion affecting the long beach fringing the north-eastern side of the island (Figure 3). According to a reliable map dating back to 1560 the recurved spit of Ras Rmel did not then exist and it is thought that erosion probably started after the sixteenth century.

The delta of the Medjerda river (mean annual discharge: 30 m<sup>3</sup>/s) is a good example of a delta in a Mediterranean environment. According to geological and geomorphological studies and taking into account archaeological data, it appears that the delta was formed 5000 or 6000 years ago by the filling up, from north to south, of a formerly drowned bay. Human activity played an important role in its evolution. Deforestation over centuries has considerably increased the solid load carried by the river, and public works (artificial levees, man-made cutoffs, drainage and deviation canals) completed during the present century have interfered with natural phenomenon. For instance, as briefly mentioned earlier, a heavy flood in March 1973 (with a water flow reaching 3500 m<sup>3</sup>/s, higher than the estimated maximum 100-year rate of discharge) caused the Medjerda River to abandon its natural channel and shift to a lower course which was originally an artificial canal, intended to evacuate excess flood waters directly to the sea. As a result, the recurved spit, which has developed at the former mouth since the end of the last century, is presently suffering erosion at its root, extending its tip and migrating westward.

Transformations of the coast on both sides of the new mouth, located about 10 km south of the former one, are also considerable. A cusplate



**Figure 2:** Progradation taking place at the present mouth of the Medjerda River

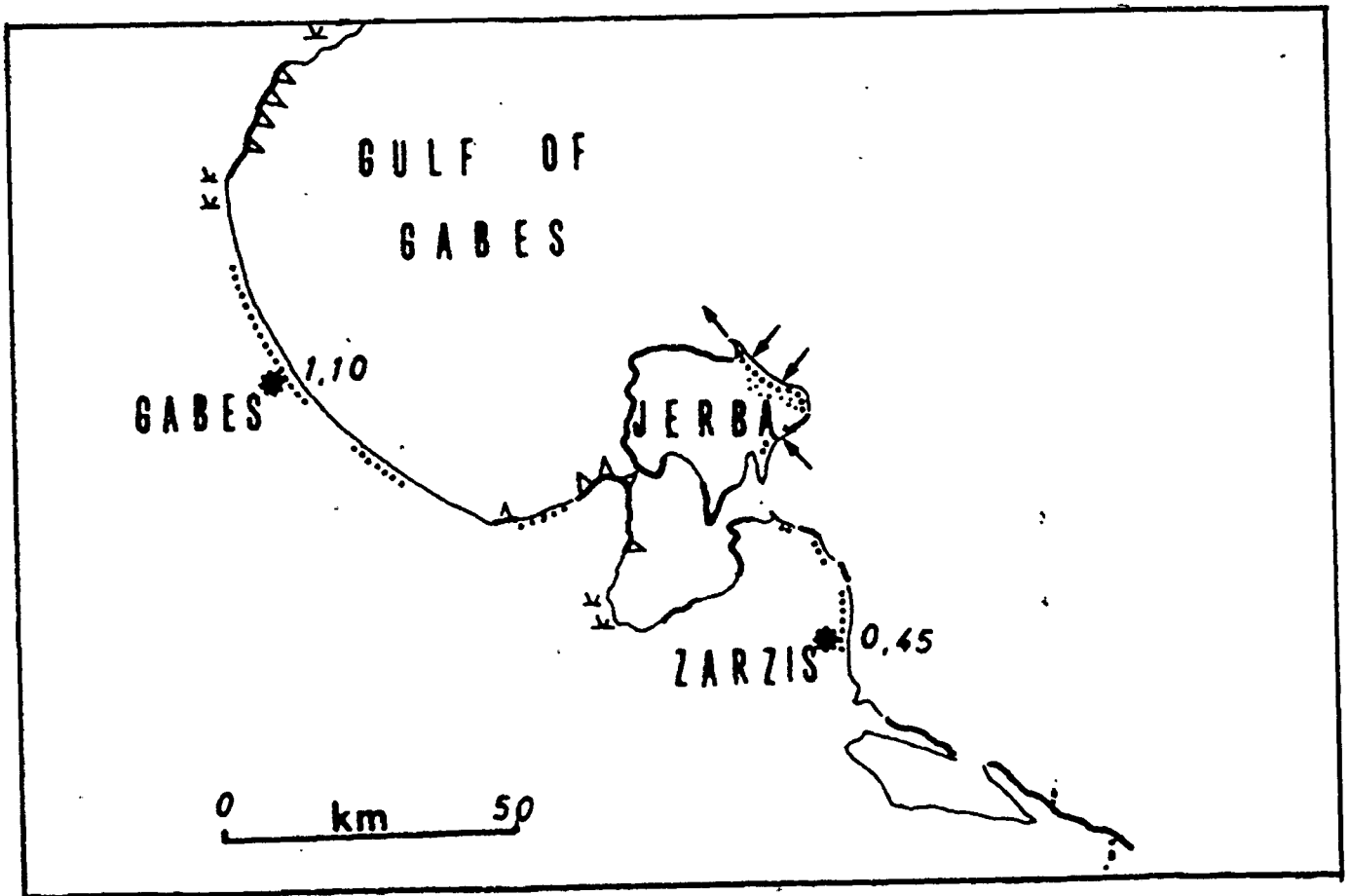


Figure 3: The severe erosion affecting the long beach fringing the north-eastern side of Djerba Island.

foreland is rapidly extending despite the fact that the movement of sediment is impeded by dams constructed on the Medjerda River and some of its tributaries. Between 1977 and 1980, about 87 acres of new land have been added to the delta.

The reader should be aware of the fact that while in the foregoing discussion the emphasis was on the erosion and degradation of the Tunisian shoreline which resulted from natural factors, in Chapter Two, Section III I will discuss the impacts of man's activities and interventions in the degradation of the shoreline. However, even though it could be argued that both factors - natural and those attributable to man - causing the erosion of the shoreline, should be dealt with under the same section, the reader should remember that Chapter One is intended to discuss the natural features and aspects of the coastal zone and its resources. Chapter Two, on the other hand, will focus on the human uses and activities in the coastal zone and their impacts on both the resources and the environment of the coastal area. The above clarification should apply also to the next section on eutrophication.

#### I.2.2 Natural eutrophication

In this paragraph I will focus exclusively on the natural eutrophication as cultural eutrophication which is created by man and results from the introduction of large quantities of organic materials in the system, mainly through urban sewage disposal, will be dealt with in more detail in Chapter Two, which will be further illustrated through the discussion of the cultural eutrophication of Lac de Tunis.

Eutrophication is intended here to be a natural process of ecological succession. To oversimplify, it is considered that a lake goes through a natural "aging" process whereby the addition of nutrients and the accumulation of sediments lead to changes in species and increases in biomass at all trophic levels, accompanied by a gradual shallowing of the lake. This is considered to be accompanied by declining hypolimnetic oxygen and an increase in mean temperature of the lake due to a decrease in hypolimnetic volume. To again give an overly simplistic description, lakes are considered to pass through several distinct phases, from oligotrophic (low nutrients, low primary

production, clear water) through mesotrophic (intermediate) to eutrophic (high nutrients, high primary production, turbid water), and sometimes continuing to dystrophic (low productivity, shallow, bound nutrients, clear but brown water with high humic acid concentrations) with eventual formation of a bog mat and, further on, passage to a complete bog and eventually a forest. This sequence of stages came then to be generally known as lake succession or the process of eutrophication.

The present day situation of the Tunisian eutrophic coastal systems corresponds to the third stage of the eutrophication process, i.e. high nutrients, high primary production and turbid water. However, and following high temperatures associated with an excessive organic load, oscillations in production levels and oxygen demand become sufficiently high (periods of dystrophic crisis) and eutrophication will become catastrophic, leading to high mortality among the fauna. Such phenomena are widespread in almost all of the lakes and lagoons of the country.

## II WHAT ARE THE RESOURCES OF THE COASTAL ZONE?

### II.1 General introduction

The coastal zone encompasses a wide variety of natural resources, one important category of which is the marine resources. The marine resources consist of those properties of the ocean and its contents from which man may benefit through his activity. It should be mentioned however, that many resources in the coastal zone are regarded as latent and may potentially be economically exploitable in the future, as developments in science and technology make this feasible. Such latent resources could then be very valuable in the future in satisfying the country's growing needs.

It is relevant to note that the coastal zone is not only important for the useful things which are taken out of it (the extractive resources, such as fish, minerals, petroleum, and water), but also is of great benefit, without taking anything out of it, for its use for transportation, recreation and for defense. In the case of waste disposal the ocean is a resource because of what we put into it. The ocean, because of its immense volume and its continual movement and

mixing, is capable of absorbing great quantities of domestic and industrial wastes and this is an extremely important resource, particularly for coastal communities.

The resources of the coastal zone can be categorized as renewable and non-renewable resources. In respect of renewable resources, the strategy of their utilization is particularly important, as it must be structured in such a way as to ensure their rate of renewal. Such strategy of use is defined as "conservation". Among the renewable resources affected by man's activities, the living resources are in a unique category, because their rate of renewal depends upon the amount of the resource left to perpetuate itself, which in turn depends on the rate of harvesting.

## II.2 The living resources

The continuing growth of Tunisia's population is placing correspondingly increasing pressure on the food resources of the country. To ensure adequate levels of food production at the present time and in future decades, national authorities are thoroughly assessing the needs and the resources. Careful examination of the problem reveals that there is no general lack of food energy, (i.e. calories), supplied mostly by the carbohydrates of plants, however the potential critical future shortages for the country could be for proteins, especially the animal proteins that are essential for people's health and well being. On a global level, the ocean has already proven to be a good source to obtain these animal proteins, and some 15% of the world's supply comes from fisheries.

At the national level, although it may not be economically feasible to harvest the full potential yield, there is every reason to believe that a large proportion of the domestic requirement for animal protein can be taken from the sea. This assertion is based on present knowledge of the fishery resources in various unutilized or under-utilized areas of the country's waters, which could be harvested with present technology. Considerable potential fishery resources exist in the area around the Cap Bon peninsula offshore Gulf of Hammamet and most, if not all the resources of the area off the northern coast having hardly been harvested



at all. Even in areas which have been extensively exploited, such as the Gulf of Gabes and the southern waters, there is still large potential yield available. Bearing this in mind, it could be concluded that the country's fishery production has substantial potential, even if no radical or expensive developments are introduced, such as, for example, fish farming and new kinds of fishing gear.

A fairly considerable proportion of the national production of fish is not presently directly for human consumption, but is instead used for the manufacture of fish meal which is then employed as protein food supplements for poultry and livestock, therefore reaching people indirectly. Protein conversion through animals is quite high (around 25 to 50%), therefore the conversion of fish protein into other forms of animal protein preferred by many people is a fairly efficient process although direct consumption of fish proteins would be more efficient. Fish canning and processing, and development of other fish products for human consumption, in acceptable form, and at low price, is progressing in many areas of the country. It is unlikely, however, that such developments will negatively affect fresh fish consumption in Tunisia, as the population has for many centuries been accustomed to the fresh fish of the Mediterranean forming a substantial part of the diet, and this tradition is unlikely to change.

Fish farming is a subject of great interest at the present time and its potential exploitation in Tunisia warrants very careful thought and consideration. The culture and rearing of marine organisms is a promising area of development in certain localities. The rearing of sessile organisms, such as oysters, clams, and mussels, has been carried out in Tunisia for some years. Rearing of certain kinds of fish, and shrimp, in enclosed ponds or embayments is also a long-established industry. Certainly the development of fish culture in inshore waters, employing organisms which, at least in their adult stages, are sessile, or are amenable to impoundment, offers great promise for further development. Details of fish production in some Tunisian lakes and lagoons can be found in Annex 1.

In the vast reaches of the open sea, aquaculture is not likely to prove feasible for a long time to come. However, it is perfectly

feasible to manage the fisheries of the open sea, by selective harvesting, to encourage the maximum production of the kinds of fish which are most interesting to the market. The management of the high-seas fisheries may therefore be more closely compared to range management than to agriculture. It is very likely that this form of management will produce greater dividends in terms of total production, than inshore fish culture, although the latter will certainly continue to be of growing importance for the production of particularly desirable and high-priced marine products, mainly intended for export.

### II.3 Minerals

The nearshore and offshore areas of the Tunisian coastal zone constitute a vast storehouse of many minerals. Presently and in the immediate future, only some of these may be recovered, as the present level of science and technology in the country cannot make it feasible and economical to expand the range of mineral extraction. However, in the meantime large quantities of sand and gravel are being quarried from the inner shelf and nearshore areas, particularly around the Island of Djerba, and in the northern shores of the Gulf of Tunis. The rapidly growing exploitation of this resource in these areas is mainly due to environmental constraints for its extraction on land.

Some of the minerals are dissolved or suspended in sea water. Salt, potash, magnesium, and bromine are being extracted now on a large scale and sea water will obviously continue to be an excellent source of these minerals. Large quantities of high-quality marine salt are being produced along the coast, a substantial proportion of which is exported, thus participating in providing foreign currency for the country.

### II.4 Oil and gas deposits on the continental shelf

The principal underwater margins of the continental masses are the continental slopes, the upper edges of which lie 200 or more metres below the sea surface. From there to the shoreline are gradual slopes, the continental shelves varying in width from some 10 km (in the north) to more than 200 km (off the eastern coast), and with considerably differing configuration and physical characteristics. Large areas of the

continental shelf are covered with sediments from various sources, with some outcrops of bare rock. From a geological point of view, the continental shelf is essentially similar to the continent, therefore the types of mineral deposits found in the continental block may similarly be expected in the shelf. The economically most important of these sedimentary deposits on the shelf is presently, of course, oil and natural gas.

In Tunisia's wide continental shelf petroleum fields are presently in production off the coast of the Cap Bon Peninsula (Tazarka field, offshore Kelibia), east of Sfax (Ashtart field), in the Gulf of Gabes and other sites. The capability now exists to drill and operate anywhere on the continental shelf, and probably much deeper if necessary.

#### II.5 Resources within the coastal ecosystems

Fish, oil and gas and minerals are not the only resources found in the Tunisian coastal zone. Other very important natural resources which must be protected are the coastal ecosystems (lakes, lagoons and estuaries) which contain a multitude of organisms, both flora and fauna. As these environmentally beneficial habitats have been dealt with at length in the first section of this Chapter, I should only emphasize here that these areas are the place where the process that underlies the entire pattern of marine life begins, i.e. the place where photosynthesis changes simple substances to complex organic compounds - carbohydrates and fats (the basic elements of life) - with energy stored in the form of chemical bonds between atoms. When phytoplankton are ingested, these bonds are broken and the food energy released. Food energy then progresses through the food chain in stages, from producers to primary consumers to second, third and fourth order consumers. It should be noted that there is a certain equilibrium to this system which is often very susceptible to the disruptive activities of man.

#### II.6 The esthetic resources

People have gravitated to the edges of the oceans and lakes all throughout the history. This could partly be explained in that their livelihood depended on the exploitation and use of water, but there could

be no doubt that other factors play an important role in the attraction of people to the water's edge. For example in a modern-day context, necessity alone cannot explain why seafront land for housing is typically sold for several times the value of land away from the shore, or why a large proportion of the population gravitates towards beaches for vacations and during weekends.

The explanation of this tendency in human behaviour is that the interface of land and water constitutes a place of spectacular visual effects, both relating to the land and water themselves and to the constantly changing atmospheric effects of fog, ocean storms, sunrises and sunsets, among other things. It is an area of natural processes extending beyond our lifetimes, such as erosion and land formation. It is a rich habitat for fauna and flora not found elsewhere. Also there are unique experiences which occur at the water's edge including swimming, fishing, sailing and other recreational activities related to the water.

### Conclusion

Before moving to Chapter Two: Resource Uses and Human Activities in the Coastal Area of Tunisia, I would like to emphasize that the purpose of presenting the coastal zone - physical features - and its major natural resources was to provide a brief insight into the wide range of the particular components and characteristics of the system which make it rather unique, potentially rich and economically important although extremely vulnerable to natural as well as man's interventions.

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Annex 1MAJOR COASTAL ECOSYSTEMS OF THE TUNISIAN COASTAL AREALake Tunis

Total area: 12,350 acres. Average depth 1 m. Salinity level reaches a maximum 50 per thousand during the hot summer months.

Production: 580 tonnes in 1977 (data of the Office National des Pêches (O.N.P.)).

Lake Ichkeul

Total area: 29,640 acres. Receives an inflow of fresh water in its western area from three principal wadis. It experiences heavy mixing of fresh water, and marine waters flowing in through Lake Bizerta to the east.

Production: 123 tonnes in 1977 (O.N.P.)

Ghar El Melh Lake

Total area: 7,410 acres. It communicates with the sea. It is located north of the Medjerda River estuary. Average depth: 1 metre. Salinity varies according to the rains which cause the Medjerda to overflow into the lake. As a result there is heavy silting of the entire southern part of the lagoon.

Production: 154 tonnes in 1978 (O.N.P.). The INSTOP hatchery is located in the eastern part of the lagoon.

Lake Bizerta

Total area: 41,000 acres. Directly communicates with the sea, through a wide channel, and therefore comprises a marine environment in the eastern area, although with an inflow of fresh water from Lake Ichkeul during winter, particularly along the western banks.

Production: 67 tonnes of shellfish in 1976 (O.N.P.).

Lake Kelbia

Total area: 27,000 acres and a maximum depth of 4 metres, after heavy precipitation. Exchanges with the sea occur through overflow during periods of heavy rainfall.

Production: 35 tonnes in 1977 (O.N.P.).

Lake Monastir (Khmiss)

Total area: 16,200 acres with an average depth not exceeding 0.5 metres. The Lake is situated between Khmiss and Monastir is part of an old salina. It has been developed and exploited by the National Fisheries Office (O.N.P.) since 1971, using fixed fishing systems (crawls). Direct link to the sea. Intensive aquaculture activity in this lake with satisfactory results, particularly mullet and sea bream.

Production: 9 tonnes in 1977 (O.N.P.).

Bahiret el Biban

Total area: 81,000 acres with an average depth of 5 to 6 metres. Dominating marine influence. Situated south of Zarzis, Bahiret el Biban is separated from the sea by a group of small islands. Fixed fishing sites (crawls) are operating in the passages leading to the high seas.

Production: 334 tonnes in 1977 (O.N.P.).

Bouqrara Sea

Total area: 135,000 acres with a maximum depth of 10 m. This coastal lagoon is directly connected with the Gulf of Gabès. Heavy tidal influence.

Production: 260 tonnes in 1976 (O.N.P.).

## CHAPTER TWO

## RESOURCE USES AND HUMAN ACTIVITIES IN THE COASTAL AREA OF TUNISIA

I GENERAL INTRODUCTION

For centuries, the Tunisian coastal zone has provided a valuable resource base for the growth and progress of this nation. The resources of land-sea interface have acted, and continue to act, as a magnet for development of all kinds - transportation, industry, housing, fishing, mineral extraction, energy production, waste disposal, etc. - while at the same time providing opportunities for recreational, scenic, historic and cultural enjoyment in a unique environmental setting. Until recently, the capacity of the coastal zone resources to accommodate these multiple endeavours has been viewed as adequate, but today the ever-increasing pressures for utilization have come into conflict with growing concern over degradation and possible misallocation among competing uses.

This chapter is intended to provide an overview of the large variety of resource uses and economic activities taking place in the coastal zone of Tunisia. Additionally, it is also intended to highlight the negative impacts and the sometimes irreversible damage inflicted on the marine environment and the fragile coastal ecosystem. We will conclude the chapter by discussing the mounting conflicts amongst the different uses of the coastal zone resources. However, we wish to remind the reader that the main purpose of the project is to discuss planning and management for efficient control and rational allocation of the coastal zone resources in order to achieve the highest national benefit. Therefore the reader should not expect us to go into detail on all these issues.

II. THE UTILIZATION OF COASTAL ZONE RESOURCES IN TUNISIA

The current rapid growth of the country's population is well known and widely discussed at all levels of the Government. Tunisia now has a population numbering something over 7.5 million, which will almost certainly rise to 10 million by the end of this century. It is to be hoped, and indeed expected, that the human population will be brought into comfortable balance with the country's resources, but before that is



accomplished there will be a great many more people to provide for than at the present time. In order for the expanding population to live healthful and satisfying lives, there is a demand for a great quantity of materials, services, and amenities. In fact, the requirements grow much faster than the population because the country's people demand better standards of living. The pressure is especially evident in the less privileged areas of the country, where a great many people are now living at minimum subsistence level.

### II.1 Urbanization in the coastal area

The abundance of resources in the coastal area has traditionally attracted, and will increasingly attract, a very large proportion of the country's population.

The shift of population to the coast which is presently taking place is comparable to the one from rural to urban areas which happened during the first half of this century in industrialized countries, and which is still happening in developing countries. This transfer of population relates to the search for better living conditions (a greater variety of resources, more job opportunities, better communications, higher recreation potential, an environment of high quality, and so on).

The population of nearly all the districts in the interior of the country is either growing slowly or sometimes decreasing, whereas the population of most of the coastal districts is increasing very fast, thus accentuating the contrast between a highly populated coastal zone and a less populated interior. More than 65% of the country's population is living in the coastal area with particular concentration in the areas of Tunis, Cap Bon (Hammamet and Nabeul) and the Sahel area (Sousse and Monastir); and the transfer continues. Presently 90% of the local population of these areas is concentrated in a fringe approx. 25-35 km wide along the coast.

This population shift brings about a growing demand for space to accommodate a great variety of competing and often incompatible uses, and an increased pressure on coastal zone resources. Traditional activities such as agriculture, stock raising, fisheries, ports, etc. have been

joined at a growing rate by residential developments. This latter has encouraged creation and development of industries, quarries and sand and gravel pits for building materials, sand and gravel operations on the shelf, hydrocarbon extraction, storage and processing, power plants, mariculture, solid and liquid waste disposal on- and off-shore, multiple forms of recreation, and tourism facilities (from large hotel and bungalow complexes to modest campsites).

In many areas - particularly in the north and the region of Sousse and Monastir, most of the coastline is a nearly continuous strip of buildings, a "concrete curtain", which in many cases has produced very serious impacts and the irreversible destruction of valuable environments.

Even areas of the coastal strip which are normally very unsuitable for human use are being transformed into "first-class" residential areas, and the areas in which the natural vegetation cover is preserved are decreasing from one year to the next.(1) Recent studies also show that a big proportion of the estuaries, inter-tidal areas and coastal wetlands have been filled or reclaimed in the last century or so for building and urbanization purposes. This was the case, for instance, when the 1.5 km distance of salt marsh between the eastern wall of the old City of Tunis (the Medina) and the present western edge of the Lac de Tunis was filled. The marsh was filled during the French colonial period, to form what is now Avenue Habib Bourguiba and the main commercial part of Tunis. Prior to the fill, the marsh received most of the wastes from the Medina, and has acted, like most salt marshes, as an effective tertiary sewage treatment plant, causing not only the oxidation of organic waste, but also the uptake of nutrients into marsh plants preventing extreme nutrient input to the Lac. The extreme eutrophication problems of Lac de Tunis (which will be dealt with separately) did not occur prior to the expansion of Tunis outside its walls and the filling of the salt marsh. The filling and occupation of such areas has caused a sharp increase in

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(1) For instance, deforestation and urbanization activities in Ghar el Melh and Raf-Raf coastal area.

the pollution of coastal waters and sediments, a reduction in fish catches and the disappearance of certain species from many areas.

There should be no doubt that during the last decades, urbanization in the coastal area has taken place in many parts of the country in a spontaneous and anarchic manner. This anarchic development has resulted in considerable damage and loss to the coastal and, most particularly, the marine environment. This is going to continue and the threat to the coastal ecosystems will increase if no appropriate measures and no integrated planning at the national level are taken to foster development and urbanization with conservation.

## II.2 Coastal recreation and tourism

The activity which takes, by far, the biggest share of the coastline in the country is recreation and tourism. A visit to the crowded seashore of the country on a summer weekend will convince any observer that a majority of our citizens look to the sea as a source of relaxation and outdoor recreation. Sailing, swimming, sport fishing, surfing, skindiving, water skiing, and simple contemplation of the beauty and majesty of the sea, and of its inhabitants, provide rest and relaxation from the stress of living and working in a complex urban society. Throughout the country the demand for outdoor recreation which has been accelerating rapidly since the sixties has been substantially increased by the flow of millions of tourists who come to enjoy the country and its beaches and water resources. All of these, and other forms of marine recreation are increasing at a rate possibly much greater than the population growth itself.

Although Tunisia is blessed with over 1400 km of coastline, about 40% of which is beach, there is already a shortage of shoreline for recreational activities, in addition to the other requirements that must be satisfied at the interface between the land and the sea. The problem we face, and which will become more exacerbated in the future, is twofold. First, with the exception of the open sea, the supply of the marine recreational resources is far less expandable than the demand. Second, coastal populations tend to be concentrated in a few areas, thus

making great demands on some parts of the seashore and nearshore waters, whereas other suitable places are underused.

The accommodation of the need for marine recreation will require the most imaginative application and development of new technology in a systematic fashion, as well as the most careful planning for the various uses of the interface between the sea and the shore. We will need to create more shoreline, to expand the use of existing shoreline by means of effective multipurpose planning and use, and to provide greater and easier access to the underused portions of the shoreline. In some locations, such as the surroundings of Tunis and particularly at Djerba Island, where beaches are disappearing due to human intervention and the modification of the supply and transport of the sediments, new means of preserving and enhancing these features need to be sought.

### II.3 Other economic activities in the coastal zone

Urbanization, tourism and recreation are not the only uses for which the coastal zone has been involved; other economic activities are also taking place. Some activities have been long established, but many of these are now being displaced by newcomers. Today, these include fisheries and mariculture, port-related, commercial and industrial complexes, energy production, the exploitation of mineral resources, and so on. Fisheries may be artisanal or industrial, while mariculture is a broad term covering 'new aquaculture', such as fish husbandry in sea farms, conchyculture and algae harvesting.

Almost everywhere, industrial activities develop, sometimes linked to maritime transport, such as naval construction and repairs, but embracing diverse demands such as steel and iron works, refineries and petrochemical installations, agrifood industries and so on.

Electrical power stations on the coast are fairly common on sites near harbours and estuaries, because of the increased demand for energy in these areas as well as for the use of sea water for cooling purposes.

#### II.3.1 Power

Another of the very important requirements for modern man is power,

cheap and abundant power being the key to the utilization of many other resources. The use of power is increasing in all parts of the country at a rapid rate. If we assume that a Tunisian population of 10 million people at the end of this century will have per capita power requirements equal to 5 kWh per day average in Tunisia, the total power requirement will be 50 million kWh/day. The sea does not seem to be a very practical source for the satisfaction of any significant share of this need. And this because a feasible situation involves an especially favourable configuration of the adjacent land, and a large tidal range. Similarly, wind power and wave power (which is generated by the wind) are a potential source of energy but because favourable locations are very few and mainly because of the state of the science and technology in our country, the development and utilization of this power source is not likely to be competitive with other sources, at least for the near future. However, in special circumstances this may be a significant potential source of useful power, and would seem to be a fruitful area for engineering research.

For the present time the principal use of the sea in relation to the generation of power in Tunisia will, at least during the next several decades, continue to be, as it is now, a source of cooling water for power plants using fossil fuels, such as coal or heavy fuels as power sources. In the typical power plant, nearly half of the energy of the fuel is lost as waste heat, which requires an efficient cooling system to remove it. For the power plants located along the coast, the sea is an excellent source of cooling water for this purpose.

### II.3.2 Transportation

Bearing in mind that 96% of the country's global volume of foreign trade (import and export) is carried by sea, it can be seen that ocean-borne transportation is a sector of vital importance to the country's growth and it represents one of the cornerstones of the national economy. Tunisia depends, for its foreign exchange earnings, apart from the considerable income from tourism, on export of large quantities of bulky raw materials (phosphates, petrol, etc.) and food products, which are totally carried by sea.

The maritime international trade of Tunisia, which totalled approximately 18 million tons in 1986, is carried, for the most part, by ships flying foreign flags. The present participation by the national flag in this total volume is about 10% by both owned and chartered ships (only 6% by owned ships). The maritime transport income of both national shipping companies (COTUNAV and Gabes Chimie Transport) totalled 70 million Dinars of a potential global market estimated at 600 million Dinars per year in 1987.(1) According to the UNCTAD Code of Conduct, the national flag is entitled to control at least 40% (240 million Dinars) of this total volume. The securing of 40% of this trade will help the country, i.a. in its struggle to improve the balance of payments and reduce its dependence on foreigners to carry its trade.

However, as the international maritime commerce of the country is growing faster and faster, there is a need - apart from expanding and developing the fleet - for modernizing, developing and improving, the actual port facilities and infrastructure to enable them to receive larger ships and, most important, to cope with the growing trend of containerization and roll-on/roll-off traffic. The need for large container storage, sorting space and other adequate shore-based support facilities will certainly affect the nature of the harbour and terminal infrastructures in the country(2) as is already happening in many of the industrialized countries.

The problem of optimizing ocean transportation involves, of course, more than the ownership and operation of ships. As we have already noted, the ships and the harbours from which they operate need to be made compatible. Decreasing the turn-around time can also be important, since about half of the time of a present-day ocean-going cargo ship is spent loading and unloading. It is further interesting to note that studies show that port costs, including cargo handling costs, accounted for 32% of the total operating costs of the vessels (including depreciation of the capital investment, insurance, maintenance, and administrative costs as well as the cost of running the vessels).

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(1) 1 Tunisian dinar = approx. 1.2 US Dollars

(2) Tunisia has 6 major commercial ports: the triple port complex of Tunis-Goulette-Rades; Bizerta; Sousse; Sfax; Gabes; and Zarzis. Plus a specialized oil terminal at La Skhira.

The movement of cargoes across the sea, and their loading and unloading at the sea-land interface, is only a portion of the system, the objective of which is to move the goods from their point of origin to their point of consumption. Thus there should also be taken into account the transportation system in the hinterland from which the cargoes originate and to which they are destined. Thus it is desirable to consider the entire system of transportation from the shipper to the consignee, of which the ocean transportation sector is only one component, although a very large one. This is a formidable problem because the complexity of the transport system is enormous when everything is taken into account. There are also serious social problems resulting from rapid technological change. However, it is evident that this is an important area of marine resources requiring a systematical approach.

### II.3.3 Waste disposal

Disposal of most of the domestic sewage and industrial wastes, dissolved or suspended in water, is being accomplished by running them, either untreated or after partial treatment, directly into the country's coastal embayments and estuaries, or into the open coastal waters. Because of the increase in population density, causing a shift from individual septic systems, local collection networks, and sewage treatment plants to large-scale interceptor sewage networks and centralized treatment plants, the use of the marine environment as a dump for liquid waste is increasing at an even faster rate than that of population growth of the country's coastal regions.

The use of this resource of the sea - its capacity to assimilate such wastes - is due to its large volume and rapid mixing, which dilute the waste, and the micro-organisms in the sea which break down the organic constituents. Any sector of the marine environment can assimilate a certain amount of waste discharge without damage to its other uses; this is a valuable and legitimate use of this environment, provided the wastes are deposited in such amounts and in such a manner that the capacity of the environment is not exceeded. However, where large volumes are run into waters of nearly enclosed harbours, the rate of interchange with the open sea may be insufficient to provide rapid

dilution, and high levels of waste products may be built up locally. Even on open coasts, it is necessary to take careful account of local oceanic conditions if large volumes of sewage and industrial waste are to be disposed of without harmful effects. It is possible in enclosed and nearshore waters to introduce even such fragile wastes as domestic sewage at a rate so great that dilution and decomposition are too slow to prevent the concentrations in the environment from reaching levels that are harmful to man and to his other uses of the environment.

After this brief attempt to discuss some of the uses and activities to which the Tunisian coastal zone has been subjected, in the next section I will endeavour to discuss the impacts of these development activities - including waste disposal - on the coastal natural environment and particularly the marine ecosystem.

### III. IMPACTS OF SHORELINE DEVELOPMENT ON THE COASTAL ENVIRONMENT AND MARINE ECOSYSTEMS

#### III.1 Erosion and shoreline degradation

Promotion of recreational use of the coastal zone is not without problems, and negative impacts on the coastal environment are inevitable. The nature of the impacts of recreational development on areas of high scenic quality and on other kinds of problem stemming from recreational pressures on the coastal zone has not yet been taken into account, specially by planners and developers.

One of these negative impacts, beach erosion, is a serious problem, particularly for a country like Tunisia where the tourist industry, predominantly based on the sea and beachside activities, has been at least for the last 20 to 25 years, one of the cornerstones of the national economy and earnings in foreign currency totalled 1.2 billion U.S. dollars in 1988. Development activities and human intervention related to the tourist boom, have no doubt considerably accelerated the recession of the shoreline, particularly in the surroundings of the Gulf of Tunis, most of the eastern coast and Djerba Island. During a period of three decades there has been sand mining on the beaches for building purposes and in many places the foredunes have been completely destroyed by erection of hotels close to the shoreline. Coastal dunes, if left



alone, would have acted as a preventive barrier to inland erosion; they are especially sensitive to abuse and can be easily damaged by vehicular traffic, paths or roads. Any of these activities breaks down the plant structure which has anchored the dune, and once a gap exists in the dune pattern, storms can penetrate and erode them. Also the construction of marinas and the over-building too close to the seashore clearly has increased the vulnerability of the shore. The building in 1975 of the outer harbour of Ghar el Melh, on the barrier that isolates a lagoon from the sea, is inducing geomorphic modifications (Figure 4). Accretion on the updrift side of the jetties protecting the entrance of the dock has been followed by erosion in the downdrift sector, depleted of travelling beach material to such a degree that the barrier has been cut off. And finally removal of dead leaves of *Posidonia*, which accumulate on the shore and inhibit sunbathing, increases wave action, which is also enhanced by the degradation of the infralittoral meadows damaged by sewage.(1)

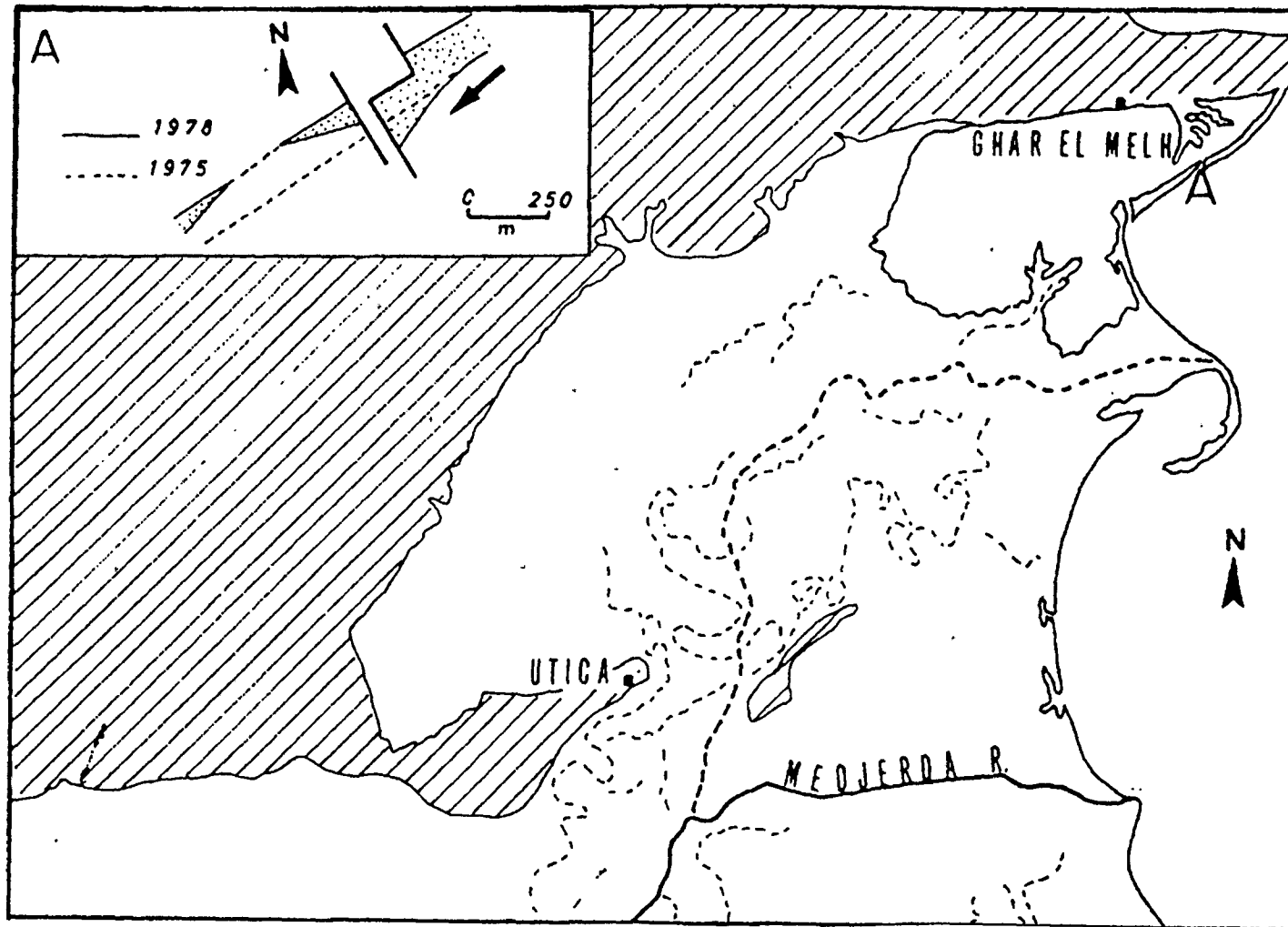
To conclude we may say that the alternating erosion and accretion of beaches is a natural phenomenon which, over long periods of time, and if not subjected to interference will produce minimal changes. It is just this interference which will cause increased erosional problems. Basically there are three ways, some of which have been mentioned above, that humans can affect coastal and shoreline areas: land recovery by dredging and filling, damming rivers, etc.; construction of jetties or other coastal structures; and the development or destruction of coastal dune areas.

### III.2 Environmental impacts of land-based pollution within the coastal area

The state of pollution in the coastal waters of Tunisia has already reached, in some areas, a critical level. This is mainly due to the high quantities of domestic sewage, discharged untreated or only insufficiently treated, into the sea through rivers, outlets and pipelines,

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(1) Phenomena, though widespread in most of the eastern littoral, is particularly noticeable in the nearshore waters around Gabes and Jerba Island.



**Figure 4:** Erosional effects caused by the building of the new harbour of Ghar el Melh.

and also due to the organic load of industrial effluents and the almost total absence of control over their toxic components and solid substances. The latter situation is particularly noticeable in the coastal waters around Sfax and Gabes industrial zones.

The environmental impact of land-based pollution is significant, because it mainly affects the coastal waters. As has been mentioned in Chapter One, these waters are sites of high biological productivity. This is due to the fact that the primary marine production of organic material (i.e. the photosynthetic plant forming the base of the food chain) takes place predominantly in these waters. In the continental shelf areas and, in the so-called "up-welling waters" within the coastal waters where mixing of nutrient rich deep water with surface water occurs, more than 90 per cent of fishery resources are produced. Pollutants injected from land into the coastal waters are often trapped by marine organisms or in sediments. Some organisms have a remarkable ability to accumulate persistent substances such as mercury and DDT from sea waters, even where substances are present in extremely low concentrations. Such contaminated marine organisms, when harvested, serve as conveyors of pollutants to their predators, notably man. Even short of poisoning marine organisms, contamination of coastal waters by land-based discharges of wastes may result in the changing of the structure of marine communities, fouling of beaches, or loss of amenity.

The control of land-based sources of marine pollution poses difficult technical and policy issues. As regards legal controls, it has generally been held that they are within the domain of national law, rather than that of international law, because the sources and effects of land-based pollution are normally confined to the areas under the exclusive national jurisdiction of coastal states. However, the increasing awareness of the ecological unity of the marine environment and of the impact of marine pollution on its natural equilibrium makes it clear that unilateral national measures are not adequate to protect and preserve the marine environmental quality.

### III.2.1 Domestic waste sources

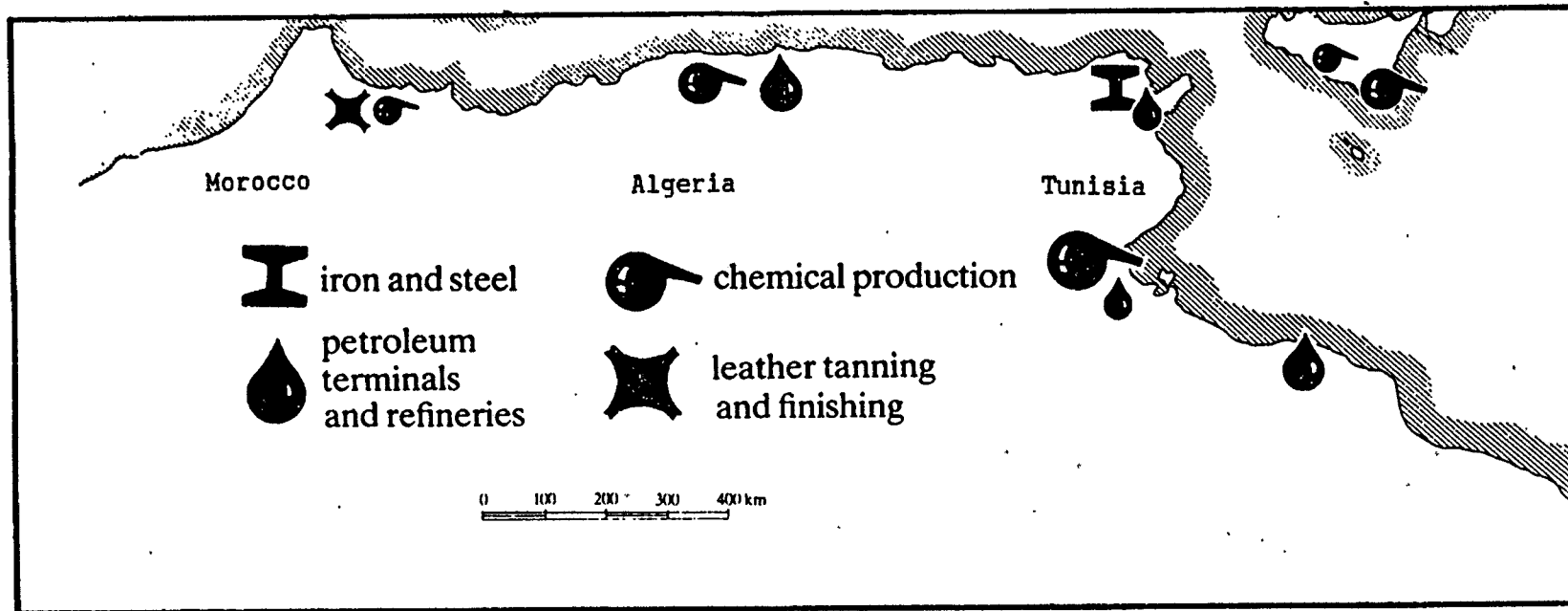
The two most densely populated regions of Tunisia's coastal zone are

the Gulf of Tunis and the Sahel with 2 million and 1.5 million respectively. There is also a heavy inflow of tourists during the summer season in these two areas. Taking into account the percentage of population not connected to public sewage systems, or using other methods not resulting in direct discharges into the sea, 40-60% of the resident population contributes to actual waste discharges into the area. The percentage may be further reduced if the sewage discharges are adequately treated, which is not presently the case. Domestic sources are the main origin of organic matter, microbial pollution and nutrients (e.g. phosphorus and nitrogen), as well as of detergents from household uses. Some industrial waste metals are also found in municipal sewage discharges.

### III.2.2 Industrial waste sources

The four major categories of the more heavily polluting industries in Tunisia's coastal area are leather tanning and finishing; iron and steel basic industries; petroleum refineries and oil terminals; and chemical production (organic and inorganic). Other industries of significance include textile manufacturing, food processing and canning, and pulp and paper factories. The geographical distribution of the first four categories of industrial sectors is shown in Figure 5. Leather tanning and finishing industries are concentrated on the northern coastline in the area of Tunis. Iron and steel industries are concentrated in the coastal area of Menzel Bourguiba some 60 km north of Tunis. The oil industry, petroleum refineries and oil terminals are found in Bizerta and La Skhira on the Gulf of Gabes. Tunisia has developed the largest chemical complex in North Africa. This industry is concentrated along the coastline around Gabes and Sfax.

The major part of the industrial waste discharges from these industries has been directly introduced into the coastal waters insufficiently treated. Industrial waste discharges contain considerable amounts of organic matter and suspended solids but more significantly phenols and heavy metals. Mineral oils are largely introduced from refineries and crude oil terminals.



**Figure 5:** Location of major North African industrial areas along the southern Mediterranean coastline.

(Source: United Nations Environment Programme)

### III.2.3 Agricultural run-off

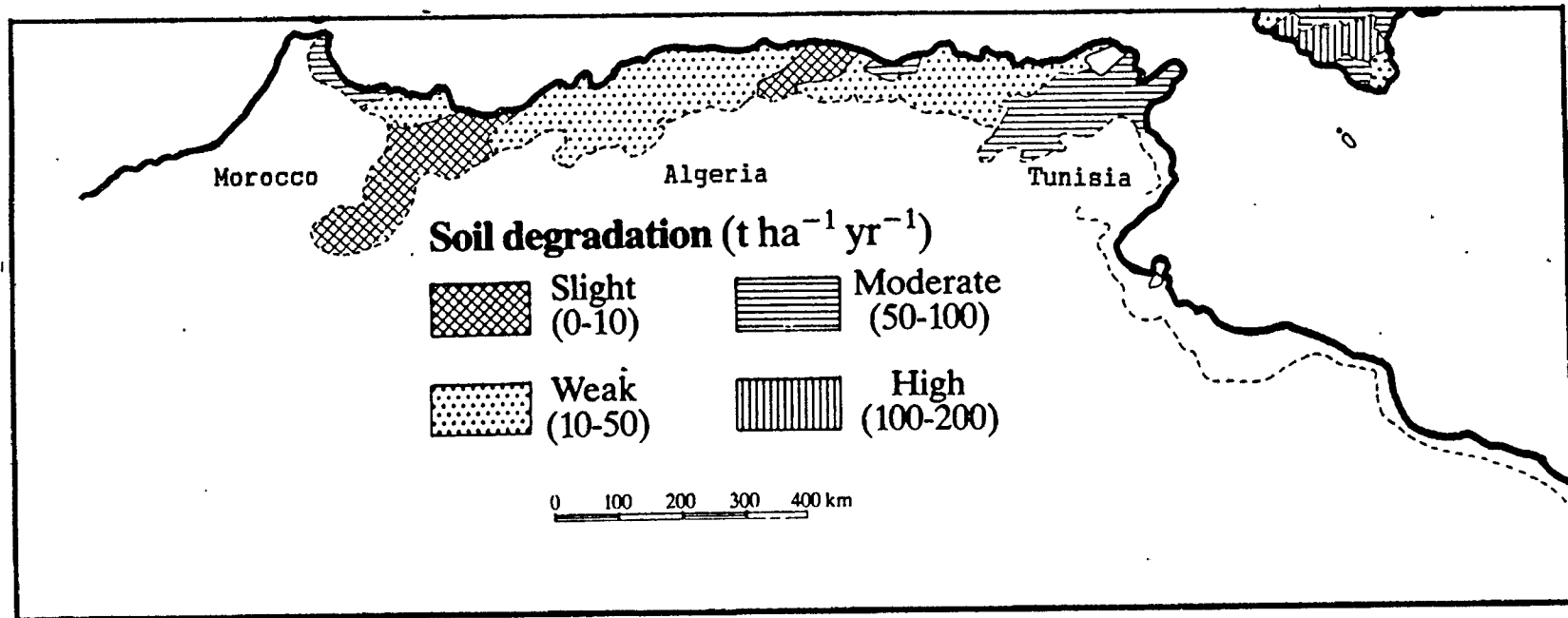
Four basic factors affecting run-off and erosion are: climate, soil, topography and vegetation cover. Agricultural run-off contributes a considerable amount of nutrients to the coastal waters. On the other hand, soil erosion in the watershed basin is the main cause of suspended solids and pesticides being discharged into the sea. However, compared with discharges via rivers and other sources, the contribution from agricultural run-off is relatively small. The geographical distribution of erosion potentials within the coastal area are shown in Figure 6.

### III.3 Magnitude and effects of some critical pollutants: Nutrients

Tunisia, like many Mediterranean nations, hopes to develop its economy through tourism, and tourism requires water for boating and swimming. The country also depends on fish as an important protein source. And all people enjoy the beauty of coastal waters. However, the accelerating urbanization of port cities, combined with changes in the economic distribution of food resources, has produced problems of coastal eutrophication in most if not all of the country's coastal ecosystems. This syndrome (eutrophication), present in some of the near-shore marine waters, lakes and lagoons is threatening to prevent recreational water use and destroys fish production and the aesthetics of a beautiful environment.

Urban wastes, high in concentrations of nitrate and phosphate, discharged into enclosed harbours and coastal lagoons has produced an increased growth of plants, i.e., microscopic algae and phytoplankton. Pollution, bad odours and a "slimy" green colour associated with excess algal growth have caused undesirable aesthetic conditions and depletion of oxygen leading to high mortality of heterotrophic organisms, particularly fish.

Restoration of water bodies is difficult because even if the source of nutrients is removed, internal recycling may retain the productivity at a high level unless there is excellent flushing and a short retention of the water. However, harvesting of macroscopic green algae, using the techniques applied to Lake Truman (USA) was tried in Lac de Tunis, but



**Figure 6:** Distribution of erosion potentials within the Mediterranean watershed basin for the North African countries.

(Source: United Nations Environment Programme)

was unsuccessful because technical problems prevented continued removal. Restoration from eutrophication apart from being difficult and expensive may not be successful. Prevention is preferable by far.

### III.3.1 An Illustrative Case: Cultural Eutrophication in Lac de Tunis

Lac de Tunis which has an area of 12,350 acres is divided in two halves by a ship canal. The northern portion of the Lac (Lac du Nord) receives treated and untreated domestic sewage from the City of Tunis, a small amount of industrial waste, run-off from storm sewers (which may be extreme during the wet season), and thermal effluent from a power plant. The eutrophication problems are mainly due to the domestic sewage and have largely developed during this century. Furthermore the poor connection with the sea has increased the eutrophication problem.

The most extreme conditions occur in late summer with the development of temporary and local anoxic conditions and the release of hydrogen sulphide to the atmosphere, with noxious odours detectable more than a km from the Lac. The most extreme conditions are reached during crises on years when there is an extended calm period. The symptoms are rafting of algae over the lake surface, development of anoxia through much of the Lac, disappearance of much of the algae, and, under the most extreme conditions, development of pinkish or reddish waters and fish kills. In 1975 the fish kill amounted to 10% of the annual catch from the Lac. Fish could be killed by either the hydrogen sulphide or the lack of oxygen. This appears to be one of the most extreme occurrences of the symptoms of cultural eutrophication reported for any natural environment.

It would appear highly probable that the problem in Lac de Tunis could be significantly reduced by diverting the major sewage outfall away from the lagoon and by enlarging the connecting canals to increase exchange into the sea. However, many other exogenous point and non-point sources of sewage exist. The sediment is also a large reservoir from which nutrients move into the water column during the frequent periods of anoxic conditions. Lac de Tunis appears to be past the point of recovery, and even after an extensive clean-up programme, will continue to pose health and odour problems for the foreseeable future.



Whether or not pessimism is justifiable may be revealed in the future after the outcome is known of Tunis' major programme of construction of new sewage interceptors for virtually all of the outfalls and diversion of sewage to new treatment plants, whose effluents are either dumped in the sea or used for land-disposal.

#### IV PROBLEMS AND CONFLICTS IN THE UTILIZATION OF THE COASTAL ZONE RESOURCES

The foregoing discussion about the potential and limitations of the coastal zone and its resources has indicated by implication important problems and conflicts that need to be solved if we are to be able fully to use these resources. In this section, I will not attempt to discuss particular obstacles and limitations for planning and managing the coastal area since this will be dealt with in Chapter Three, nor propose or recommend solutions for rational use and management of the resources since it is covered in Chapter Four of this project. However, what will be briefly discussed here is some of the socio/economical problems resulting from the use of the resources.

Many of these socio/economical problems arise from the fact that the coastal environment and its resources are by their nature, rather different from the resources of the land, so that the institutional and legal arrangements that have developed on the land apply imperfectly here. For example because of the fluid nature of the sea, which is in constant motion, what is introduced in one place may rather quickly affect other locations. Waste materials introduced into the marine environment at a given location may influence people living at considerable distances away. Thus large areas of the sea need to be considered as a unit with respect to pollution problems. Moreover, our approach to manage and allocate the resources of the coastal area must be different from that on land and should take into account the particular features and peculiar characteristics of this unique system.

Conflicts arise both over different uses of the same resource, and over uses of different resources in the same location. Many economic and social consequences arise from the physical and geological exploitation of the coastal zone. Whether an activity is coastal, offshore or open

sea, such activities as processing, transportation and marketing of a marine product will have socio-economic and political ramifications. Economic and environmental conflicts between various types of users of the coastal zone are often inevitable and deep-seated. Priorities always create a dilemma for coastal zone management. It should be possible to find solutions to these disputes over alternative uses of a given resource through clearly outlining all the facts concerning the nature of the resource and possible alternative uses, taking into account economic and social considerations, and with full public discussion with concerned parties.

Problems relating to the uses of different resources in the same region can be equally difficult. These problems are most critical along the land interface with the sea, and the adjacent shore, and in the marginal sea some few miles from shore. It is in this zone that the sea is used for recreation in a variety of ways, where there are important commercial fisheries as well as sport fisheries and where the greatest potential exists for fish farming. This zone also is where we most conveniently dispose of many of our domestic and industrial wastes. It is at the land-water interface that we must transfer ocean-borne cargoes, and where certain types of industrial plants for processing extractive resources from the sea must be located. Also, it is in the sea bottom underlying nearshore waters that the important, and most easily exploitable, deposits of minerals and petroleum are frequently encountered. Determination of the proper mixture of uses presents a most difficult and complex set of problems.

In seaside towns, the parties concerned are the landowners whose property has its value enhanced by its proximity to the sea; the building contractors and the trades people who thrive on the summer tourist industry and are all in favour of a longer season. The declining groups, who benefit very little from the growth of the tourist industry, are the farmers - whose number is decreasing, and who are growing older - and, to a lesser extent, the fishermen.

An area which is ideal for touristic purposes may also be ideally suited for other conflicting uses, for example the establishment of a harbour, a petroleum terminal, or an unsightly but sorely needed

artificial island with a waste processing factory. As a result real estate values can soar to unprecedented heights, causing local inhabitants to sell their property and move away, resulting in the development of other expensive coastal areas for residential use.

Fortunately, some of the conflicts that have arisen in the past have been more imaginary than real, and others have been capable of resolution by rather simple technical measures. There must remain, however, conflicts which are real, and where decisions will need to be made regarding alternatives. This category is bound to increase with the increasing utilization of the sea's resources. Choices that will have to be made, if they are to be made for our maximum benefit, must be based on adequate information, both in respect to the nature and extent of the resources, and in respect to the various economic and social benefits to be derived from them.

Unfortunately, some decisions once made and acted on are economically irreversible. For example if we decide to fill an embayment to create additional land, such a decision is essentially economically irreversible, even though it may later be determined that some other utilization would have been more beneficial. It is, I believe, therefore most urgent that we obtain as rapidly as possible a fairly complete inventory of the potential resources of the marginal sea, and of the lands lying along the interface between the land and the sea, as a basis of rational planning of the optimum uses thereof. In those cases where decisions are economically irreversible, we should be particularly cautious about making them, until really required to do so, so that we may preserve as many options as possible for future contingencies.

Inherent in the problems of utilization of the coastal resources, as for other resources, are important considerations concerning their conservation. For this purpose, conservation may be considered as the allocation of use of a resource over time, in relation to the expected flow of future benefits and costs. For some resources - the nonrenewable resources - there is a certain fixed quantity available for use, which may be used rapidly or may be used slowly. For the renewable, or flow, resources, the problem is rather different. For some of these, where our use of the resource does not affect the quantity that will be available

in the future, we have no reason to take heed for the future supply. For other flow resources, where our use does affect the future supply, we have carefully to consider the future supply. As inferred above, this is particularly important where the use of the resource is such that its diminution may become physically or economically irreversible.

I have only touched lightly upon several of the foregoing topics, and have not even begun to elucidate their complexities. It is hoped, however, that this brief discussion will provide at least a little insight into the economic and social constraints within which coastal zone terminology must be developed.

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## CHAPTER THREE

## PART I

GOVERNANCE, ORGANIZATION AND MANAGEMENT OF THE COASTAL ZONE  
RESOURCES IN TUNISIA: LIMITATIONS AND DIFFICULTIES

It has been highlighted in Chapters One and Two that the Tunisian coastal zone through its present and potential natural resources and the wide range of related economic activities, represents an important and essential element for the development and growth of the country's economy, and the welfare of its people. It can be seen that the broad range of coastal uses encompasses, inter alia, food supply, transport and communication, waste disposal, energy, recreation, and tourism. Additionally it can clearly be seen that the increase in population which is taking place along the coastal strip generates more urbanization.

The result of this great variety of coastal uses, and the increasing numbers of users, is a growing scarcity of unused spaces and conflicts created by incompatible uses. Additionally, unlike natural systems which generally maintain a stable long-term balance through self-regulating and maintaining mechanisms, human use tends to involve single-purpose additions and changes which are not necessarily in harmony with existing natural systems. Therefore, having in mind the natural limitations of the resources of the coastal zone, and the mounting conflicts over their use, the necessity to address the issues of governance, planning and management is inescapable. A system of authority or control is necessary to allocate the coastal resources to those uses most beneficial to the national interest, whilst maintaining and protecting the environmental balance.

I TOWARDS A SYSTEM OF GOVERNANCE FOR THE COASTAL ZONE:  
DIFFICULTIES AND LIMITATIONS IN TUNISIA

The coastal zone, apart from being a natural system governed by the natural law and the geophysical dynamics which have regulated it for millions of years, is also a socio-political system accommodating a large variety of different groupings, each struggling for survival and expansion, and competing among themselves. Each grouping, which consists

of the sanctioning agency as well as the users' group, works to expand its territory vis a vis other groups in a constant competitive struggle for increased resources and access. For example, the offshore oil industry would relate to a national constituency and a particular governmental agency, while tourism or fisheries will relate to another constituency and a different agency. If both groupings (constituencies and agencies) have similar powers and comparable influence at the highest level in the political sphere - which is often the case - this can lead to a situation where conflicts fail to find rapid and easy solutions, therefore resulting in the loss of a valuable opportunity to develop and exploit the national resources, to strengthen the country's economy and to improve the people's welfare.

Thus, it could be said that utilization of the coastal zone lacks an explicit and uniform system of governance. No one group or organization can internalize the collective impacts resulting from the diverse uses to which the coastal zone is subjected. No one organization or group presently has the means to identify and reconcile or accommodate other user groups, therefore users who have adverse experiences or whose interests have been affected will choose the course of making a political issue of them in an attempt to influence the political choices made in respect of the resources or development activities of concern to them. However, the Government generally would only be sensitive to, and react, if the issues in question become prospectively or sufficiently critical to it politically. For the Government, an issue would not necessarily be classified as critical, simply because it was deemed to be so by one particular group, for instance, the scientists. This might be fortunate, or unfortunate, as the case may be, but the purpose here is not to make judgement on the value of different interests, but rather to emphasize that a system of uniform and consistent governance is lacking for the coastal zone in Tunisia. As a result, not only the resources and the opportunities they offer run the risk to remain under-developed and poorly exploited but the whole concept of "coastal zone", as a system of governance is threatened.

Scientists, as one among the several groups with an interest in the coastal zone and its resources, attempt to influence coastal policy.

However human behaviour does not respond to increased information alone. Therefore it could be said that the wide array of conflicting and heterogeneous uses found within the coastal zone cannot be rationed and resolved simply by providing more scientific information on impacts and effects of such uses on each other, on the one hand, and their impact on coastal ecology and the marine environment, on the other. Instead, users respond to incentives generated by the various and multiple laws, rules, organizations, and known information in relation to their own preferences, incomes, and perceptions of the resource base.

It would seem, therefore, that the need exists for a forum where the interests of all stakeholders actually present in the coastal zone can be more adequately displayed, thus permitting better communication of fundamental values, and the exploration of the constructive compromises that are the essence of governance. Economic and environmental interests are an issue too large and vital to the national interest for ad hoc coordination and consultation to work effectively. A single forum that can demonstrate the capability to protect the values of all stakeholders could gain the trust and credibility needed to establish and maintain itself. Nevertheless, the variety of fora now available does tend to demonstrate a certain resilience in governance, although with a complexity that can obscure fundamental values, complicate communications, and hamper speedy resolution of conflicts. Development of a system of joint problem definition and problem solving will clarify who speaks for, and decides about the coastal zone, and under what procedural safeguards. At that point, more effective governance will commence.

## II THE ORGANIZATIONAL STRUCTURE AND THE DISTRIBUTION OF AUTHORITY FOR THE COASTAL ZONE IN TUNISIA: ANOTHER CONSTRAINT ON POLICY IMPLEMENTATION

The national organizational structure could be the next deficient link after the lack of a uniform and explicit national political forum for the governance of the coastal zone. Does the present organizational structure constitute an obstacle for the implementation of a uniform and integrated policy, rational management, and efficient and optimal allocation of the present and potential coastal zone resources? This is



what I will try to answer in this section. However, the reader should be aware of the fact that even though there may not be any concrete and final solution to the problem I strongly believe that addressing the problem is already an important step forward since understanding it, and exposing the basic reasons underpinning it should contribute halfway to finding a solution.

Tunisia has a wide range of organizations that are directly controlled by the decision-making of the executive, legislative and the jurisdictional branches. Among these organizations there is no coordination, cooperation and very little crossover and each of them, in order to be successful in its sphere, must satisfy the multiplicity of interests surrounding it. Therefore, each level of the Government, and each of its agencies, act separately in limited technical spheres with selected aspects of uses that in combination, all impact on the coastal zone. As a result, even in the event that a coastal zone policy is promoted by well-meaning, hard-working, and often zealous professionals, the net result, in the sense of real national interest, often can be zero.

This fragmentation which produces inconsistent and piecemeal policies that are wasteful and ineffective, represents a serious impediment to integrated planning and implementation of a unified policy for the control and management of the coastal zone resources, and - more importantly - jeopardises the already precarious economical situation of the country.

Apart from a slow and obsolete nation-wide bureaucratic system, other more "modern" and complex elements are at the basis of this fragmentation such as destructive and undeclared competition amongst the public administrative bodies/agencies with responsibilities for one or more sectors in the coastal zone. The following section should be a brief and modest attempt to discuss and clarify these new obstacles and constraints which contribute to this destructive fragmentation.

#### II.1 The organizational behaviour in the Tunisian institutional framework

As we know, the distribution of managerial authority in the

organizational structure has both a vertical and a horizontal component. In the former case, the problem is how to resolve authority conflicts among national and district levels and how to determine who has control over the actual implementation of policy. In a highly centralized state like Tunisia, it is not uncommon for purely local or regional interests to be translated into national policy rather than vice-versa because the centre is always under pressure to be more responsive to the periphery and, in sea use planning, for instance, the centre is in fact quite sensitive to local desires particularly vis-a-vis the near-shore environment. The farther out from shore the activities occur, however, the less the influence of the local or district level on the centre.

The horizontal problem, the other component of the distribution of managerial authority in Tunisia, consists of a variety of national agencies, each having responsibility for one or more sectors of coastal use and each seeking to expand its jurisdiction and control vis-a-vis competitor agencies and organizations. The major problem is how to effectively coordinate policies across these agencies at the national level so that the national interest can be served. The dynamics of organizational behaviour are very likely the major element of the problem since they appear to be the greatest organizational constraints on the implementation of policy and the major factors, if not the only ones, behind the limitations and the shortcomings of the Tunisian organizational infrastructure.

The Tunisian organization, as any organization in most countries of the world, is a human system in which realization of the group goals is only one of several important needs to which the organization is oriented. Otherwise expressed, much of the behaviour that goes on in the organization is oriented to the needs of individuals more than to the goals of collective decision-makers. Actually, what is happening is that the organization endeavours to survive and to maintain equilibrium, and that emphasis on survival may be to the neglect of formal goals. Organizations, therefore, become ends in themselves, and the informal structure of behaviour is regarded as being far more real and important than the formal structure as defined by the organizational chart.

The dynamic of organizational behaviour has been clarified by Haas and Drabek (1973) in the following statement:

"Whereas necessity may be the mother of invention, it is clear that the designer's objective for the organization is not its sole father. And now we come to what every founder of an organization knows but may hate to admit: designing an organization does not necessarily ensure that it will become what the designers had in mind at the time. Once the social system is set in operation, an increasing proportion of the evolving official normative structure and resource structure develops in response to the jockeying among the organizational groups for autonomy, security and prestige."

This dynamic - the struggle to survive and expand - (autonomy, security and prestige) constitutes the basis, therefore, for the internal organizational behaviour, as well as its behaviour vis-a-vis other organizations in the same task environment, i.e. other organizations doing similar jobs. Since resources are finite and since programmes translate directly into budgetary allocations, organizational growth and development are areas of potential conflict of interest, because gains to one party usually incur losses to others.

The reader should not forget however that what we are looking at here is fragmentation of the Tunisian organizational structure and what we tried to demonstrate (in the above discussion) is that organizational behaviour, in the coastal zone policy establishments of the country, is certainly one of the major elements (if not the only one) at the origin of this fragmentation and dispersion of resources and energy. As a result of this situation, a national programme for the coastal zone will be dispersed through several organizations in four or five governmental departments (Ministries and Secretariats of State). The consequences of this condition are that there are too many actors, too many separate chains of command, too many cross-cutting policies, too many separate budgets, appropriations and programmes. In this confusion, national priorities have no perspective and neither the Executive Branch nor the parliament is in a position to lead effectively, much less enforce accountability for results.

## PART II

A PROPOSAL FOR SOLVING GOVERNANCE AND ORGANIZATIONAL  
INFRASTRUCTURE LIMITATIONS IN TUNISIA:  
A COASTAL ZONE MANAGEMENT PROGRAMMEI. INTRODUCTION

It appears from the above discussion that the fundamental coastal zone resources problem in Tunisia is thus institutional rather than functional. The authority for managing Tunisia's coastal zone resources is fragmented among several individual agencies. Each has some degree of responsibility and authority to establish and enforce standards for the use of the resources, and to undertake actions which will in one way or another affect the quality and quantity of these resources. Presently there is no central body responsible for establishing basic policies for the conservation and development of Tunisia's coastal zone resources or for placing those policies within the context of the country's overall environmental, economic and social goals. Therefore there is a keenly felt need for an integrated coastal zone resources planning and management programme which will be consistent with broad national policy objectives, will reflect the interests of all national agencies involved and will provide guidance for action by both the public and private sector. This proposed programme will be referred to as the Coastal Zone Management Programme (CZMP). It is also recommended that a policy-making body for the management of the coastal zone resources be created. Accordingly, our proposal is a sort of coordinating agency under the direct supervision of the Prime Minister's Office, with responsibility, i.a., for coordinating and harmonizing policies and activities affecting the coastal zone which emanate from the numerous existing agencies. This agency will be called the Coordinating Coastal Zone Management Agency (hereinafter referred to as the CCZMA). The role and responsibilities of this agency will be dealt with later in this chapter.

The integrated coastal zone resources planning and management programme, (which will be referred to hereafter in the thesis as the CZMP) should, i.a., enable sound environmental resources management and protect environmental values. It should prevent Tunisia's

regulation bureaucracy from being found arbitrary, discriminatory and fragmented by the public, it should promote consensus on policy for coastal zone management and enforcement of regulations.

Problems in the areas of coordination, public misunderstanding, and centralization of control processes in respect of coastal zone use control process should be identified and dealt with quickly and efficiently.

1. Coordination: as was shown above, there is a lack of coordination between national agencies having responsibilities for use of coastal zone resources. Coastal zone planning and related regulations are fragmented by the absence of good channels of communication and the lack of a comprehensive national policy for the uses of the coastal zone resources. Individual decisions regarding coastal zone use have not contributed to the attainment of longer term national purposes, which purposes are in any case not clearly defined. Insufficient funds and personnel expertise have also impeded programme definition and coordination, as well as the improvement of interagency communications.

2. Public misunderstanding: emphasis on regulation must be accompanied by parallel efforts in public education and other means for conserving environmental resources. Too heavy focus on regulation can lead to misunderstanding by the public of the need for such measures and to resentment against the constraints on private action imposed by them. It is essential that the public is made aware of the purpose of regulations and to engage the public interest in actively conserving and protecting resources in the long term national interest.

3. Centralization of control processes for use of the coastal zone: centralized management of the regulatory system can easily lead to lack of public involvement, and resultant hostility and misunderstanding. Laws and regulatory procedures which are intended to cope with resource problems of national rather than local concern, nevertheless affect people where they are. If the administration is too centralized and does not take into account regional and local interests, serious problems can arise.

By improving the country's planning structure to serve the regulatory systems, the CZMP should be a response to these management problems. Whilst new environmental legislation is required, ways to improve the operation of existing laws and organization must also be exploited and implemented. Regulatory legislation must be concerned - at least at the start - with the issues that needed immediate attention. There are major environmental problems caused by large-scale development. Wetlands and the entire intertidal zone must be regarded as valuable ecological resources requiring special attention. Development in the shorelands within 100-150 m of mean high water must be considered to have a critical influence on both land and water resources along the coast. Particular areas of scenic, historic, scientific, recreational and other environmental values also have to be identified and protected. Regulatory legislation must therefore be concerned with these issues that need immediate attention.

Major elements of the national legislation should be concerned with the site location of development, wetlands protection, mandatory shoreland zoning, and a register of critical areas, and should provide the legal foundation for coastal resources management. Private initiative should be allowed maximum scope, but nevertheless development must take place with due regard to environmental conservation and use of available resources to the greatest national benefit. The regulations should give clear guidance on environmental performance criteria in respect of large-scale development. Areas which should have limited use, either because of natural hazards or alternatively their unique, scarce, or fragile nature, should be clearly delimited. Within these established constraints private initiative and private activity should be encouraged.

## II LEGAL STATUS OF COASTAL ZONE MANAGEMENT PROGRAMME

One important objective is to ensure, through the national law, that the CZMP is more than just another planning document. The management programme must demonstrate that it represents the official policy and objectives of the Government. This will require it to be documented in the management programme that the Government has formally

adopted the management programme in accordance with the rules or procedures established by the national law.

The programme should be identified, by this law, as the means by which the Government proposes to exert control over use of the coastal zone resources, and should include a listing of relevant constitutional provisions, legislative enactments, and regulations.

Such an account of the legal foundation of the management programme should certainly indicate the powers and authority which are available to the Government, and to its jurisdictional subdivisions, for implementation of the programme. However, identifying the legal tools available for programme implementation does not preclude the need for formal adoption of the programme by the Government, which should include a formal statement of approval of the programme by the President or First Minister on his behalf.

The rules and regulations must empower Government agencies involved in carrying out the coastal management programme to have police power authority to regulate land and water uses; to have eminent domain power to acquire ownership or interests in property needed for national uses or projects; there should be a designated lead agency - the COZMA - to administer the programme; and formal approval of the management programme by the President or First Minister on his behalf.

### III POTENTIAL INCONSISTENCY BETWEEN THE PROGRAMME AND THE VARIOUS PRESENT LAWS

In establishing priorities among permissible uses for the coastal areas, the Government must evaluate all present national legislation to determine how it might affect coastal zone use. Present national legislation tends to be of a single-purpose nature. As the coastal zone programme is implemented, in all probability inherent inconsistencies between the programme and provisions of present national laws will appear. This is very obvious since much of the national legislation would have been established prior to the formation and promulgation of the comprehensive coastal management programme. If necessary, in the national interest, previously enacted legislation may have to be modified or eliminated to develop legislative consistency with the

coastal zone management programme. It will be primarily the task of CCZMA to identify necessary changes as they are encountered. To a large extent it will be through the development and implementation of the comprehensive coastal planning and management programme that the national interest in the coastal zone can be defined and implemented in a rational way. While the designated leading agency (the CCZMA) will be charged with working within the framework of existing law and distribution of authority, it should also, through its unique management position, constantly evaluate present legislative frameworks and make constructive proposals to the government for changes to meet evolving needs.

#### IV PARTICIPATION/INVOLVEMENT OF DISTRICTS IN COASTAL ZONE PLANNING

The CZMP and the related regulations should contain a requirement that district views must be taken into account in the Agency's (CCZMA) coastal management decisions, and districts given an opportunity to comment upon major decisions prior to their implementation. This is of particular importance with reference to coastal land development decisions.

The role of the district should be clarified and specified in the implementation of the CZMP. However, authority and control over the submerged lands, water column and surface waters of the territorial sea should be exclusively delegated to the CCZMA, as there are areas of potential difficulties in the case of an opposite arrangement. The primary problem is one of coordination and monitoring. Especially when dealing with a deep water activity, there are already a number of national authorities involved and if in addition districts should become involved the likelihood of confusion and dispute could be expected. On sensitive matters of jurisdiction, the Government should entrust full responsibility to the national leading agency (CCZMA) as it would be unusual for districts/local communities to incorporate an extensive list of national interests within its local plans and policies.

Whilst the views of coastal districts must be an element in the elaboration, and later implementation of the CZMP, coastal districts



should nevertheless give fullest consideration to the national interest of the country. In fact the district proposals and programme recommendations, in both the stages of elaboration and implementation of the CZMP, should not be accepted and included unless the national interests (as opposed to narrow, district/local interests) principally affected by such proposals and recommendations would have been adequately considered.

The district recommendations and proposals for resource uses and economic activities in its coastal zone must be formulated in full cooperation and coordination with relevant national agencies, district agencies, regional organizations, port authorities, and other interested parties, public and private.

No matter how many specific elements are identified within the CZMP there should be some guidance as to what the national interest might involve, and how it might be determined. For instance, there exists a national interest in defence, safe navigation, elimination of water dumping, improvement of water quality, enhancement of recreational areas, commercial fishing and support of the national merchant fleet. The national interest in these areas can be very broad in scope but they still provide an overall framework within which the district can work.

The intention, and the wish in involving districts in coastal zone planning and management is that it should produce a dialogue and cooperation between district officials and the national leading agency and their respective staffs. Responsibility for regulatory policy should be left to the COZMA officials, and they should retain the authority to adopt and amend development decisions and regulations. Nevertheless, they should receive assistance and advice from district and local personnel and in such a way consistency and unity in policy should be greatly facilitated and planning and regulation problems should to the maximum possible extent be avoided.

Plans prepared by district planning commissions for use of coastal zone resources are intended to be an important input element and management tool. Furthermore, local and district planning should stimulate public awareness and participation, and should to a great

extent minimize local misunderstandings through greater awareness of the factors involved in decision-making for coastal zone resource utilization.

The CZMP, and related regulations which will be promulgated to implement its provisions, should give detailed information about the criteria that will be used by the CCZMA in reviewing district programme proposals and recommendations for land and water uses in the coastal zone with the respective jurisdiction of various districts. In general, programme proposals should address the following points:

1. Major problems and issues within the district coastal zone caused through external factors;
2. Objectives for a district inter-agency management structure with responsibility for identifying issues and problems, putting forward proposals for resolving conflicts, and efficiently administering regulations at the district level;
3. Objectives of the management programme for preserving, protecting, developing, restoring and enhancing the nation's coastal zone.
4. Policies for protecting and conserving natural systems within the coastal zone, for example areas of cultural, historic, or scenic value, and renewable and non-renewable resources; policies also for preserving, restoring and economically developing selected coastal areas within the district.

#### V THE CCZMA: ROLE AND RESPONSIBILITIES

The present highly fragmented organizational structure and the wide array of operating agencies with responsibilities for resources in the coastal zone no doubt has led to frustration among many owners, developers, and citizens who are affected by it. It is for this reason that the recommendation is made to create a coastal zone resources management policy-making body under the direct supervision of the Prime Minister's Office.

The CCZMA, as the agency responsible for the implementation of the Coastal Zone Management Programme, should be responsive to executive

policy and not to the interests or clientele pressures of any particular operating department. However such an agency may have difficulty persuading other agencies/departments of its coordinating role and authority, and the result could be inter-organizational conflict rather than cooperation. The fact that the Agency would be under the direct supervision of the head of the Government (the Prime Minister), though, should make it easier for it to carry out its responsibilities and accomplish its tasks.

The law creating the CZMP should require that the process of development and adoption of the coastal programme offers the opportunity for full participation by relevant national and regional agencies and organizations, port authorities and other interested parties, both public and private. The intent of the law is to ensure that the Government is aware of the full array of organized public and private interests in the coastal zone, that it has provided them with the opportunity to participate in the development of the coastal programme, and that it will continue to consult and cooperate with them. The management programme should, therefore, include a list of such agencies and organizations, the nature of their interest, and the opportunities afforded them to participate in the development of the management programme.

The planning activities of these agencies which are established by Law, should not be ignored by the CCZMA. Moreover, the coastal management programme may benefit from the expertise, experience, and the information made available by local, regional and other planning organizations, through their recommendations and proposals.

CCZMA activities should include:

1. Coordination and harmonization of policies and activities affecting the coastal zone, which emanate from the numerous existing agencies, within the framework of the CZMP.
2. Establishment of basic policies for the conservation and development of Tunisia's coastal zone resources and for placing those policies within the context of the country's overall environmental, economic and social goals.

3. The initiation, in cooperation with the other concerned agencies, of a capability to monitor and assess the impacts of existing and proposed uses of Tunisia's coastal zone resources.
4. The formulation of management programmes and regulations for Tunisia's coastal islands.

It should not be the intention that the CCZMA would formulate all environmental management and coastal use plans itself, or run all the regulatory machinery. The CCZMA will be primarily concerned with identifying areas and activities of national concern and coordinating the formulation of comprehensive nationwide environmental and development policies in accordance with those national interests. Thus the framework would be established for working out coastal zone use policies at the national level and introducing and coordinating controls at the district/local level.

#### VI PROGRAMME REVISION

The CCZMA should be assigned the tasks of determining the future direction of Tunisia's coastal planning programme, priorities for research, and an integrated coastal and marine policy. In relation to the problem of revising the coastal management programme, the CCZMA should have the job of suggesting a new direction that will satisfy the national requirements and also have popular support. This will involve the formulation of complementary strategies for coastal economic development with measures for conservation of coastal resources. Development of recommendations on policies for exploitation of oil and gas resources on the outer continental shelf will be an additional task.

#### VII PUBLIC PARTICIPATION

Having in mind the particular nature of the coastal zone in Tunisia on the one hand, and the need to respect property rights on the other hand, makes public participation in coastal planning and management of particular importance. The introduction of new legislation for environmental protection and resource uses in the coastal zone will no doubt as a consequence create certain problems and expenses in its implementation and enforcement. District and local

officials and citizens must of course be fully informed and involved and should reach their own assessment of the necessary means to carry out their responsibilities in that respect.

The need for education is acute; an important element is advice and assistance to enforcement officers who must, in the final analysis, be the persons responsible for successful accomplishment of the purposes of the Coastal Zone Management Programme and the related regulations. The public participation programme should, therefore, be particularly directed towards planners, conservation commissioners, and others who have a direct responsibility for, or interest in the laws affecting land and water uses in the coastal zone.

As the main element in this educational process, consideration could be given to establishing a programme of cooperation between the CCZMA and district planning agencies by which means local input into the CZMP and related policies may be generated. Public participation efforts must, therefore, be tied into the activities of the district planning agencies. Resource inventories and analyses would form the primary information base for concerned parties to consider conservation and development issues and devise policies to deal with them. These policies would provide the overall framework within which coastal use regulations could be administered and would give officials the basis for implementing controls directed towards achievement of established goals.

Two-way communication is to be encouraged as local input is highly desirable in the formulation of the national coastal policy and the programme. Important contributions can be made by people who actually live in the coastal communities. Therefore, the CCZMA may consider to hold a series of regional meetings to provide a forum for discussion of coastal management issues. These would serve the dual purpose of education of Government officials by the local people as well as vice versa.

In addition to the institutionalized device of regional meetings, the Government - through its leading agency, the CCZMA - should develop a range of public information activities to help give the people a broader perspective on the environmental values of the Tunisian coast

and the ways in which the Government proposes to conserve and protect them through the coastal zone management programme. Already organized environmental interest groups should be identified and contacted, and enthused to participate in achieving defined objectives. Articles and news releases about the programme and notices of public meetings should appear in specialized newsletters, magazines and other newspapers. A variety of booklets and pamphlets could also be prepared to disseminate information about the coastal programme and environmental legislation. To receive as well as give information, the COZMA should take a public opinion poll to find out the attitudes of coastal people toward a policy for the area. Public awareness and participation would be an important tool in achievement of national objectives and interests in use of the coastal zone.

A significant institutional device for public participation could be the establishment of coastal advisory committees in each district. Their responsibility would be to review and comment on the coastal zone programme. It would be important however to ensure that they are not simply presented with policy decisions already made at the national level but that they would also be in a position to suggest alternative policies on major issues of coastal management. Among the channels for communicating coastal advisory committee ideas to the Government would be their advisory input into the programme proposals made by the coastal districts.

It is not enough for the Government to have a strong body of environmental protection laws and a strong leading agency to implement it. Effective coastal management would also require understanding and acceptance of the programme by the people who are directly affected by it.

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## CHAPTER FOUR

THE NATIONAL COASTAL ZONE MANAGEMENT PROGRAMME:  
A RATIONAL TOOL FOR COASTAL RESOURCES MANAGEMENT  
AND ENVIRONMENTAL PROTECTION:

## CONCLUSIONS AND RECOMMENDATIONS

I THE GENERAL FEATURES OF THE CZMP

The management programme should rely on a detailed inventory of coastal resources for basic information about area development potential, identification of areas of critical concern, priorities for development, location of uses of regional benefit and national interest, and regulation of land and water uses.

The management programme should not simply expand the traditional techniques and procedures of urban land use planning to cover the whole coastal territory. Tunisia's coastal zone should certainly not be divided into areas with fixed boundaries in which designated uses will be segregated from one another. Instead, the coastal zone as a whole must be carefully surveyed to determine its capability for continued urbanization and development and to identify areas which should be restricted to limited use or conserved in their natural state. Criteria and standards should be formulated by which to assess the environmental impact of development, and to judge whether the particular development use is appropriate for the site chosen by the developer. The leading agency (CCZMA) and the relevant national institutions should apply this regulatory procedure nationwide.

Additional development parameters should be specified in the CZMP and related regulations concerning the shores of coastal waters and inland bodies of fresh water. A national register of critical areas should provide the basis for negotiation with landowners in these areas for the conservation of their environmental values.

The management programme also should have a more detailed shorelands component. Shoreland should be defined as the area within 100-150 m of the mean high water mark of tidal waters and certain freshwater ponds and streams. Here, in addition to the CCZMA,



districts, as has already been emphasized, should have responsibility for effective participation in the design and layout of the CZMP and the enforcement of its provisions once promulgated. Here also, the CZMP should contain national guidelines which should provide an informational and procedural framework for district enforcement. The CCZMA/district partnership should be facilitated through the CZMP which would provide technical assistance to district/local authorities and identify regional or local environmental concerns and development objectives. Coastal zone management in Tunisia should not be intended to be a purely bureaucratic enterprise. The policy framework and objectives have to be determined by the political process that culminates in the Parliament. Of equal importance, but more difficult to define and comprehend, is the direct input of Tunisia's citizens into management decision-making.

The national coastal zone management programme (CZMP) should not be so much a single document, but also a process wherein: (a) data is gathered and analysed, (b) the facts are made known to the concerned authorities, bodies and citizens, (c) a decision is made as to the desirable future of the coast, and (d) the logical steps to proceed towards achieving that future should be outlined.

A comprehensive coastal zone use programme would identify which activities should have the greatest priority in using the coastal lands, submerged lands, the water column and/or the surface waters of the territorial sea. It should specifically identify which activities are to be permitted within coastal areas, and thus, which activities are to be prohibited.

To summarize, the CZMP must involve these major operations:

1. identification of the boundaries of the coastal management zone;
2. definition of what shall constitute the national benefit relating to uses of the coastal zone resources;
3. establishment of procedures and organizational structure for managing the coastal zone.

The proposed Programme should also contain:

1. a definition of what shall constitute permissible land uses and water uses within the coastal zone which have a direct and significant impact on the marine environment and coastal ecosystems;
2. an inventory and designation of areas of particular concern;
3. broad guidelines on priority of uses in particular areas, including specifically those uses of lowest priority.

Also, while formulating the CZMP, another area of policy conflict would have to be resolved. This consists of the two objectives of protecting ecological, cultural, historic and esthetic values whilst meeting needs for economic development. These two factors are inextricably linked, but are not particularly compatible. Converting land, water bodies, and wetlands from their natural undeveloped state to use for some economic advantage, including use as a repository for wastes, is bound to have some effect on their air, water, land and biological characteristics. The management programme will have to include procedures and criteria for determining an acceptable balance between facilitating and promoting economic development whilst safeguarding against environmental degradation.

## II DETERMINING PRIORITY OF USES

The CZMP should not assign priorities for specific uses in particular areas. Instead, national guidelines should be defined for high and low priority uses in various categories of areas of particular concern either for development or for conservation and protection. Determination of priorities should be based on continuing analysis of national and regional development needs, as well as their potential effect on the area's resources. A rigid ordering of priorities is precluded by the variability of characteristics and impacts of potential uses and by the changing natural and socio-political environment.

An important step in meeting the intention of this section is the establishment of a viable process and mechanism to define priorities, and revise them on a continuous creative basis.

General priorities for uses of the coastal zone have to be contained in the national laws that provide the legal foundation for the CZMP. Therefore, the CZMP and the law creating it should define what are considered the "highest and best uses" of the Tunisian coastal zone.

Within this framework, the duties of the CCZMA will be:

- to refine and clarify coastal zone priorities,
- to review, revise and update priorities and policies for land use in the coastal zone,
- to provide the process and mechanism for considering goals and objectives, policies and priorities for the country's coastal zone as a whole.

Within the general requirements for ordering priorities, the CZMP should specify particular kinds of use to which high priorities must be given and for which areas must be designated. These are: (a) consideration of the national interest involved in the siting of facilities whose purpose is to meet requirements other than purely local in nature, (b) areas for preservation and restoration, and (c) uses of national benefit.

The coastal management programme must pay particular attention to preservation or restoration of coastal resources. The programme should, therefore, establish standards and criteria for designating areas for preservation because of their conservation, recreation, ecologic or esthetic values. Areas so identified should be treated as Areas of Particular Concern, and should be ranked in order of priority for action to be taken according to availability of financial resources.

### III USES OF NATIONAL BENEFIT

Development activities having national impact must have Government permits issued in accordance with the provisions of the CZMP. Local authorities should be given the opportunity to support or oppose such proposals, but final decisions would be made by the CCZMA. Criteria for decision-making in respect of such "national impact" projects should be concerned primarily with their possible harmful effects on the environment, and also with due consideration being given to their

potential regional or local benefit in the evaluation procedures required by the CZMP.

As a complement to designating areas and priorities for protection or preservation, the management programme must also develop and apply a method for determining uses of national benefit. It must ensure that district and local land and water use controls do not arbitrarily or unreasonably restrict these uses. Many public services and infrastructure facilities, such as energy production and transmission, recreation and transportation are important to a larger region, perhaps to the whole country, than the single local community/interest in which they may be most advantageously located. Uses such as offshore petroleum extraction and associated onshore refining and transportation along a particular section of the coastline may be important elements of a national policy to maintain adequate energy resources. National defense programmes may also require coastal facilities in strategic locations. Whilst these activities may not comprise the most desirable use of the area according to local interests, local communities must nevertheless be persuaded by the national coastal management programme to accept a fair share of social responsibility.

#### IV DESIGNATION OF AREAS OF PARTICULAR ENVIRONMENTAL CONCERN

Areas of particular environmental concern should be identified on the basis of the coastal resources inventory and analysis. Government concern in respect of resource uses in these areas should ensure those uses to be consistent with the public interest. The 'public' interest is difficult to define because different 'publics' are involved: property owners, entrepreneurs, and the general public, for example. Taking into account all these elements, through the identification and reconciliation of these conflicting interests, the national interest may be identified. Areas of particular national concern should be identified on the basis of these characteristics:

1. Natural hazards: tidal and freshwater flood plains, land subject to erosion or subsidence, other areas that may be dangerous to life or property.

2. Significant natural, scientific, historic, cultural, or archeological resources.
3. Areas under intense development pressure that significantly affects the general public: examples are the shorelands and the accessible areas close to highways.
4. Valuable natural resources: these are of actual or potential economic significance to the nation; they include mineral deposits, agricultural areas, sites suitable for aquaculture.
5. Ecologically sensitive areas: fresh- and saltwater wetlands, beach and dune systems, and other areas vital to the functioning of natural systems, which are vulnerable to destruction by development.
6. Recreational resources: of concern because recreation demands are increasing in the coastal zone and most land with recreation potential could also be used for limited private purposes or similar narrow local interests.
7. Scenic areas: scenic views are among the most important values and resources of the Tunisian coast.
8. Routes for public access: public rights to use coastal areas may be nullified by private ownership of the bordering lands.
9. Biological habitats: terrestrial and aquatic areas supporting significant populations of species which are valuable for commerce or sport, or which are rare and endangered.

The legal basis for improving the management of these areas of particular national concern should be found in the CZMP and the related regulations.

## V ESTABLISHMENT OF COASTAL ZONE BOUNDARIES

Because coastal zone management will have legal parameters based on the CZMP and related legislation, a legally definable boundary of the country's coastal zone will have to be an important feature in the management programme. Conservationists are likely to favour an ample coastal zone while developers and local authorities, anxious for economic expansion will favour a narrower area being subjected to restrictions on

development. However, definition of the coastal zone should include the following procedures:

1. Determination of the inland boundary necessary to control uses of the shorelands that would have a direct and significant impact on the coastal waters;
2. Determination of the seaward boundary off the coast;
3. Identification of intertidal areas, salt marshes, wetlands and beaches;
4. Identification of public domains and lands and those held in trust by the district or local authorities, whose uses are regulated by the Government.

On the basis of the above-established procedures, the Tunisian coastal zone should be defined in terms of four sub-zones, to be managed according to the provisions of the CZMP:

#### 1 Upland Developed and Undeveloped Areas

For planning purposes the widest band of upland territory is marked by the coastal watershed boundary. For management purposes, however, the jurisdictional boundary of the first tier of towns on tidewater delimits the developed uplands. High-impact development, which comprises projects with buildings over 20,000 square metres of ground area or covering more than 20 acres, must receive Government permits according to procedures prescribed by the relevant provisions of the CZMP for this entire sub-zone.

#### 2 Shorelands

This is the band of upland area 100-150 m from mean high water. Here the COZMA, in cooperation with district authorities, regulates all land uses as required by the shorelands zoning provision of the CZMP.

#### 3 Intertidal area

The entire area within the reach of tidal influence should be regulated under the wetlands control and protection provisions of the

CZMP. Permit applications should be submitted to the municipality concerned for initial comment and review, and then permits would be issued by the CCZMA, taking account of the views of the municipality as an element in the decision-making process.

#### 4 Offshore area

The CZMP should establish the seaward boundary of the Tunisian coastal zone as the outer limit of the Tunisian territorial sea, which is 12 nautical miles from shore. The CCZMA, under the supervision of the Prime Minister's Office, coordinates management controls and policies in the area. The principal agencies that have statutory responsibilities in the offshore sub-zone are represented and participate in the drafting of proposals, recommendations and policies, submitted to the Prime Minister's Office by the CCZMA.

Areas of critical environmental concern should be also identified as part of coastal zone boundary determination.

## VI RESOURCES INVENTORY

The management programme should show how the Government has developed and applied a procedure for identifying land and water uses in the coastal zone that have a direct and significant impact on the coastal and marine environment. An operational definition of "direct and significant impact" is required to show how various land and water uses affect the coastal and marine ecosystems. The programme should also analyze the development capability of each type of resource and suitable uses that may be made of them; and the environmental impact of reasonable resource uses should be assessed.

To identify permissible uses of land and other resources in the coastal zone an inventory of its natural and man-made resources would have to be prepared. This would also provide the information base for designating and mapping areas of particular environmental concern which could be defined as those areas whose unique characteristics, vulnerability, or biological productivity require that they be carefully protected. Others areas are of particular concern because of urban

concentration where there is great competition for use of land and water, or areas where exploitation of biological and mineral resources must be carefully managed.

#### VI.1 The Natural Resources Inventory

There should be two major elements of the national coastal zone management programme data base. They are inventories of natural and socio-economic resources. The natural resources inventory provides information about economically exploitable resources as well as those that must be conserved and protected. Without such information it is not possible either to make accurate assessments of the environmental impact of various kinds of physical development or to formulate programmes for encouraging economic development or improve job opportunities and income for the resident population. (In this context, Chapter One and part of Chapter Two could be seen as an overall broad introduction to a natural resources inventory of the Tunisian coastal zone.)

Some of this information had already been accumulated by various national agencies, but much of it must be collected by new field surveys. The Department of Geological Sciences of the University of Tunis, in cooperation with the relevant Ministerial departments, should collect and map the physiographic information. The Soil Conservation Directorate of the Ministry of Agriculture should provide soil maps. Water quality studies and classification should involve the Water Directorate and the Ministry of Health, and biological studies should be produced by the Institut National Scientifique et Technique d'Océanographie et de Pêches (INSTOP) and the Commissariat Generale à la Pêche. The Ministry of Tourism and the Ministry of Transport should also contribute to this inventory in their respective fields of responsibility and expertise.

Coordinating the entire natural resources inventory effort should be the CCZMA. Once the inventory maps have been completed they should be published, together with other descriptive information, in a Coastal Resource Atlas. As the atlas is intended to serve the needs of citizens



as well as professional contributors to resources management decision-making, it will be designed to be readily understandable by laymen.

## VI.2 The Socio-economic Inventory

Information about the social and economic factors affecting the coastal zone is more difficult to obtain and analyze than information about natural resources. Uncertainty about future events makes forecasting social change difficult. Nevertheless, the CCZMA should assemble information to prepare social and economic profiles of communities in the coastal zone and forecasts for the direction of change. This information may be helpful in determining trade-offs between economic development and resources conservation. The socio-economic inventory should have the following components:

1. Population: relevant management programme information on age profiles; town population growth rates, and how they are influenced by births, deaths, and migration; the direction of population movement within the country; and peak seasonal population.
2. Taxation: real property tax data about local and other governmental financial resources and the effect of development on the tax base.
3. Land use: roads and other transportation facilities, water supply and sewerage systems, public service facilities, and land in private use for residence, commerce, and industry.
4. Economics: data to show trends in taxable sales, value of manufactured products, wages, bank deposits and loans, occupations, agriculture, and revenues and expenditures of district and local authorities.
5. Housing: inventory of the housing stock and its condition, housing needs, and housing construction.
6. Transportation: Information about the existing land and water transportation systems as well as their capacity to meet present and future demands.
7. Education: survey of levels of educational attainment of residents

in the coastal zone and attendance at various kinds of schools.

8. Recreation: information about the economic impact of tourists, trends in park attendance, beach usage and the location of various kinds of facilities.

Other social and economic information should also be collected, including poverty and health indices, mineral production, and fisheries supply and demand. The complete inventories of natural and socio-economic resources should provide the basic data for developing the CZMP, as well as its revision and updating. Their management application should focus on the use and development capability of lands and waters. There should be no attempt to designate specific uses for various land areas, but rather to identify suitable general uses.

Inventory data should be assembled and synthesized to produce the following maps of significance for the programme:

1. Areas of particular state concern: environmental hazards; ecological fragility; important habitats, scenic areas and locations of development pressure.
2. Suitability of land and water areas for selected activities of major national concern: designation of sites for selected kinds of large-scale development; suitability of surface waters for waste discharge caused by development; and priorities for various uses.
3. Preliminary national and regional land use plans: designation of areas for broad categories of land use: land use class I - moderate- to high-intensity development; class II - low-intensity developments; class III - agriculture and resource management; class IV - areas with significant public values.

## VII DETERMINATION OF PERMISSIBLE LAND AND WATER USES IN THE COASTAL ZONE

The coastal resource inventory provides the information base for determining permissible land and water uses in the coastal zone that "have a direct and significant impact on coastal and marine ecosystems". The management programme should not specifically permit or exclude particular uses from the coastal zone. Instead it should provide

performance standards and an analysis of land capability and suitability based on the resource inventory as guidelines for local zoning of the shorelands and for public or private action of development and protection of the coastal zone resources.

Land uses considered to have direct and significant impact on the coastal and marine environment should be generalized into three categories for the purpose of formulating development standards and assessing the suitability of coastal lands for each of these classes of land use. They are: (a) large buildings with over 20,000 square metres of ground areas; (b) large subdivisions over 20 acres in area that rely on individual septic systems for sewage disposal; and (c) large subdivisions served by sewage collection systems.

Lands in the coastal zone should be mapped and designated as (a) suitable, (b) of intermediate suitability, or (c) unsuitable for each of these major categories of land use. Analysis of the carrying capacity of coastal lands should be based on information about their natural features and characteristics as determined in the preparation of the coastal inventory. Particular determining features are:

1. Soils and surface geology with poor drainage, instability, or other conditions that make sites unsuitable for construction and maintenance of large buildings.
2. Bedrock geology that is water-bearing, unstable, or otherwise unsuitable to support foundations for large buildings.
3. Areas of particular concern, such as those having scientific, historic, or scenic value or flood plains, wetlands, beach and dune systems, shoreland areas vulnerable to erosion, wildlife habitats, or other environmentally or ecologically sensitive areas.
4. Capacity of surface and subsurface waters to assimilate polluting discharges that current technology cannot avoid, which may result from development.

In supervising local zoning in the shorelands sub-zone and in reviewing all applications for permits for the three classes of land use in the uplands sub-zones that have direct and significant impact on the

environment, the CCZMA should apply these performance standards:

1. Pollution control: the developer has the financial capacity and technical ability to meet air and water pollution control standards, and has made adequate provision for solid waste disposal, the control of offensive odours, and the securing and maintenance of sufficient and healthful water supplies.
2. Traffic movement: the developer has made adequate provision for traffic movement of all types out of or into the development area.
3. Effect on the natural environment: the developer has made adequate provision for fitting the development harmoniously into the existing natural environment, and the development will not adversely affect existing uses, scenic character, or natural resources in the municipality or in neighbouring municipalities.
4. Soil types: the proposed development will be built on soil types that are suitable to the nature of the undertaking.

#### VIII NATIONAL REGISTER OF CRITICAL AREAS

The CCZMA should be directed to establish the Register to express official interest of the Government in identifying and conserving areas of critical environmental or historic concern. The process of registration begins with the identification by the CCZMA of areas considered critical. After investigation of candidate areas and explanation of the programme to the land owners concerned, CCZMA may recommend registration to the Prime Minister. If there is a preliminary decision that the area qualifies for registration, land owners should be given 3 months to comment. After this period, the Minister should make a final decision about registration.

Property owners in registered critical areas are required to give the CCZMA 3 months' notice before undertaking any alteration of their land. During this period, the CCZMA could try to arrange with the owner ways to avoid destruction of significant environmental values. These may include cooperative agreements, easements, or public purchase of the property. The primary objective of the CCZMA would be to seek the

cooperation of the owners, national and local agencies, and conservation organizations to protect and conserve the critical areas.

Therefore, projects by government agencies and private developers may be affected by several of the CZMP provisions and regulations, and they must be able to find their way through this complex system of laws and procedures.

#### IX ADDITIONAL TOOLS FOR THE CONTROL AND MANAGEMENT OF THE COASTAL ZONE RESOURCES

There are a number of devices the CCZMA can use through the CZMP to regulate the use of the coastal zone. These should include licensing, leasing, control of public investments, taxation, shore access policy, permitting processes and impact statements, and zoning.

##### - Licences and permits

As has already been indicated, the CCZMA should have the authority to issue permits and licences for activities taking place in or making use of coastal zone resources. As part of such systems, detailed information should be required, performance standards imposed and reasonable administrative fees charged. This will provide the CCZMA with a screening process as to who wants to do what. It will also provide a degree of protection for coastal zone users, assuring that equipment is safe, rules known and necessary technical competence obtained. Such regulations, while constituting a permit system that allows reasonable use, will provide the public with detailed information about activities occurring within the coastal zone and what impacts those activities may have.

##### - Leasing

Either public or private users having consulted and obtained agreement of the CCZMA, could be allowed to lease bottom lands and in some instances, by extension, areas of the water column. The advantage of leasing over sale is that conditions could be placed in the lease to ensure that if any activity begins to impart an unacceptable impact upon coastal resources, the right to use that resource could be revoked. Leasing allows use, while retaining ownership with the public.

- Shore Control of Access

Most if not all coastal water activities require some type of shore access, for support facilities or initial entrance to the water environment. By regulating the pattern of shore use, the CCZMA can also strongly influence the patterns of water use. The CZMP should have a new shore access planning element. In the preparation of this plan consideration should be given to coastal water priorities, and to how the shore access plan can support such priorities.

- Taxation

Public tax policy is often used to encourage or discourage patterns of human activity. A tax holiday granted to a desirable project, a differential tax rate, or a special assessment to cover unusual public costs or particular private benefits are all rather familiar tools that could be extended into the management of the coastal zone. However, there are stringent legal restrictions upon how the taxation powers can be used, and there remains a danger that desirable coastal activities may be discouraged by this or other tools, if used improperly. Also, parliament has reserved the right of taxation in some instances and it will require careful legal and fiscal analysis if such tools are to be effective.

- Establishment of Zones

In order to protect the natural coastal zone environment, to control conflicts among activities, or to protect or promote one or more preferred uses, the establishment of zones should be considered. The objective of a particular zone should be a factor in the processes and methodology used to establish it.

One approach which could be considered for the country as a whole, is to define a type of network of activities taking place within the whole coastal area, to be supplemented additionally with factors of space (the area occupied by the activity) and time (for example, in the case of an estuary the data might include seasonal migrations of fish populations, tidal variations, etc.) and any other such factors relevant

to the activity involved. The objective would be to accommodate the maximum number of uses, whilst taking account of space and time factors, with the minimum amount of conflict between uses or negative environmental impacts.

Whilst land-use planning tends to concentrate more on spatial parameters, the time element is of great importance in comprehensive coastal zoning, as coastal zone activities and natural systems within the zone are considerably more time sensitive and the time factor can be critical in determining a successful allocative pattern.

As the overall coordinating body, the CCZMA should have the authority and responsibility to decide on permissible and prohibited uses for specific areas, and for creation of Areas of Special Concern. However, any of the competent administrative bodies involved in management or control of one or more of the resources in the coastal zone should be responsible (and have the necessary competence) to evaluate zoning needs in its particular area, and making specific proposals in that respect to the CCZMA, for consideration and incorporation in overall zoning plans. Such a procedure, whilst it may seem time-consuming, would no doubt considerably contribute to the avoidance of conflicts which could potentially arise where zoning actions affect interests (both public and private), thus creating jurisdictional conflicts among the different administrative bodies affected by such zoning decisions.

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