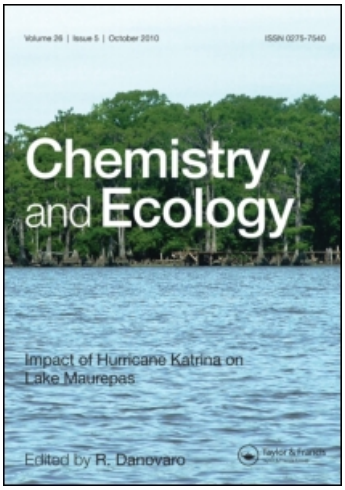

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COASTAL ZONE PROBLEMS AND MANAGEMENT: A BRIEF REVIEW

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A brief summary of coastal resources and their exploitation related problems is herein reported. Firstly, the coastal zone is defined from a geomorphological, biological and juridical point of view. A short description of coastal environments and their nomenclature follows, together with a brief review of the exploitation of the coastal zone resources. Particular attention is paid to the problems of either natural or man-induced origin, related to the intense occupancy of the coastal zone area. Finally, an action plan is schematically presented, in order to wisely use and manage littoral zones and try to preserve littoral units and ecosystems.

Keywords: Coastal zone; Coastal environment; Coastal resources; Coastal management

1 COASTAL ZONE DEFINITION

The coastal zone is the interface between the land and the sea. In reality, the coastal zone does not exist as a measurable or even clearly definable entity, but as an idea, a concept of an area where land and sea meet and merge.

The concept of the 'coastal zone' or 'coastal fringe' is vaguely defined. It varies not only according to the geographical area, but also according to the point of view of the different specialists. Thus, oceanographers, geologists, ecologists, geographers, engineers, economists and planners might use the same term with different meanings, although they all agree about the importance of this zone for mankind. Herein the term is understood to include the inner part of the continental shelf, the coastline and a hinterland a few kilometres in width.

In general, the coastal zone may be considered to include at least all that area below water that is mobile in times of strong wave movement and all that area above water that is affected by the marine environment. Clearly, the perception of the coastal zone will vary depending on the resource being considered. The standards of coastal zone delimitation vary, depending on different countries and regions.

No attempt is made here to establish precise limits for this zone. The coastal fringe is the interface between the atmosphere and lithosphere. It constitutes a high-energy zone with very active and complex dynamics, in which the Quaternary record shows clearly a history of considerable instability. It is logical to assume that this instability is going to continue, and probably even increase because of human intervention. The dynamics of the coastal

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zone represents in many cases a situation of delicate equilibrium, which can be easily affected by natural or man-induced processes. The impact of these processes can be felt far away, in time or in space, from the source. Well-known examples of this are the deforestation of the upper zones of river basins or the damming-up of rivers, both of which affect the sediment balance of the coast and, consequently, beach evolution; pollution along navigation routes; mining operations on the outer shelf or industrial activities with their effect on the CO_2 contents of the atmosphere and its possible effects on sea level. Therefore, the solution of land-use problems in the coastal zone requires careful planning, more so than in other regions. Again careful planning needs prior knowledge of the area to be exploited. Thus, research and inventory must precede land and resource-use planning.

1.1 Morphological Definition

According to an international morphological definition, the coastal zone is a portion of earth determined by an emerged zone and a continental margin. The continental margin is a zone separating the emergent continents from the deep-sea floor; it generally consists of the continental shelf, the continental slope and – according to some authors – the continental rise (see Fig. 1).

However, no objective method exists to determine the limit until where the coastal zone is separated from the land. Geomorphologists consider the coastal zone as consisting of continental environments, transitional ones and even marine ones; it consists of an emerged land, influenced by marine effects (e.g. during violent storms and high spring tides) and by a submerged portion, whose limit is conventionally given by the wave effects and bottom tidal currents.

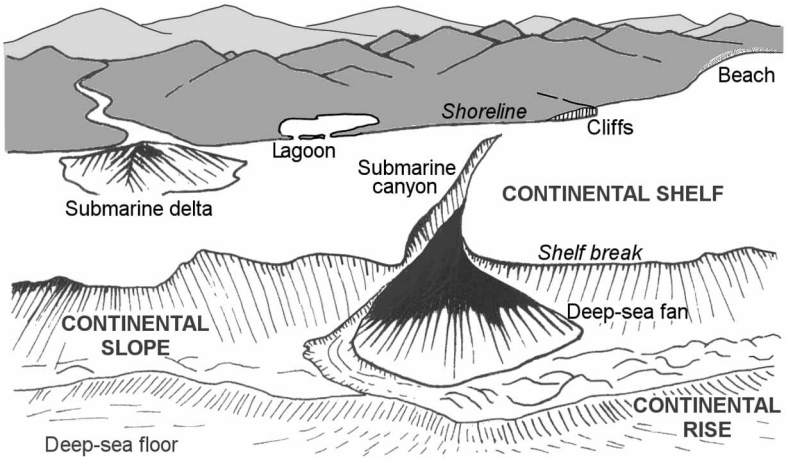

FIGURE 1 Sketch of the continental margin and some typical coastal environments. The *continental shelf* is a relatively shallow extension of the landmass surrounding nearly all continents; it is tens of meters deep compared to the thousands of meters deep in the open ocean, and extends outward to the continental slope where the deep ocean truly begins. The *continental slope*, which connects the continental shelf and the deep-sea floor, begins at the shelf break, or where the bottom sharply drops off into a steep slope; it usually begins at 130 m depth and can be up to 20 km wide. The continental slope, which is still considered part of the continent, together with the continental shelf is called the *continental margin.* Submarine canyons cut through many of the continental margins. Some of these have been carved by turbidity currents, which are bottom currents that carry lots of sediment, building up deposits known as deep-sea fans. Past the continental slope, we find the *continental rise*: as currents flow along the continental shelf and down the continental slope, they pick up and carry sediments along and deposit them just below the continental slope; these sediments accumulate to form the large, gentle slope of the continental rise.

1.2 Biological Definition

According to the biologist, the coastal sea is composed of the portion of the marine ecosystem which is included between the continental shelf and the shoreline. Furthermore, coastal domain is the definition of that share going from the surface to a depth of 50 m (euphotic zone). The portion on the land is correlated with specific vegetation that varies depending on the different regions.

1.3 Juridical Definition

From a juridical point of view, with regard to the submersed part, the coastal zone is defined as the portion which extends for 12 nautical miles from the baseline[1] (territorial waters). With regard to the emersed portion, the coastal zone is defined in terms of infrastructures, industries, urban and recreational activities which are located on the land–sea area.

2 COASTAL ZONE DYNAMICS

In many cases coastal dynamics represents a situation of delicate equilibrium, which can be easily affected by natural or man-induced processes. The impact of these processes can be felt far away, in time or in space, from the source. Well-known examples are the deforestation in the upper reaches of river basins or the damming-up of rivers, both of which affect the sediment balance of the coast and, consequently, beach evolution; pollution along navigation routes; mining operations on the outer shelf; or industrial activities with their effect on the CO_2 contents of the atmosphere and its possible effects on sea level.

3 COASTAL ZONE NOMENCLATURE

Different types of coastal environments exist within the coastal zone. First of all, it is necessary to distinguish the lowlying coast from the high one (Fig. 2; see also Fig. 1). High coasts are formed by coherent or semi-coherent rocks. They determine some kinds of environments regulated by marine erosion. Where cliffs are developed, they limit the landward extent of the coastal zone.

Low coasts form depositional environments. Beaches, fluvial inlets (deltas and estuaries), lagoons, tidal flats belong to this type of coast.

3.1 Beaches

The beach is the zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach is the mean low water line.

Generically, a shore may be subdivided into three areas: backshore, foreshore (or intertidal zone), and shoreface (or inshore).

[1] *Baselines*: according to the law, these are lines which delimit the extensions of the inner water on the land and territorial waters in the sea.

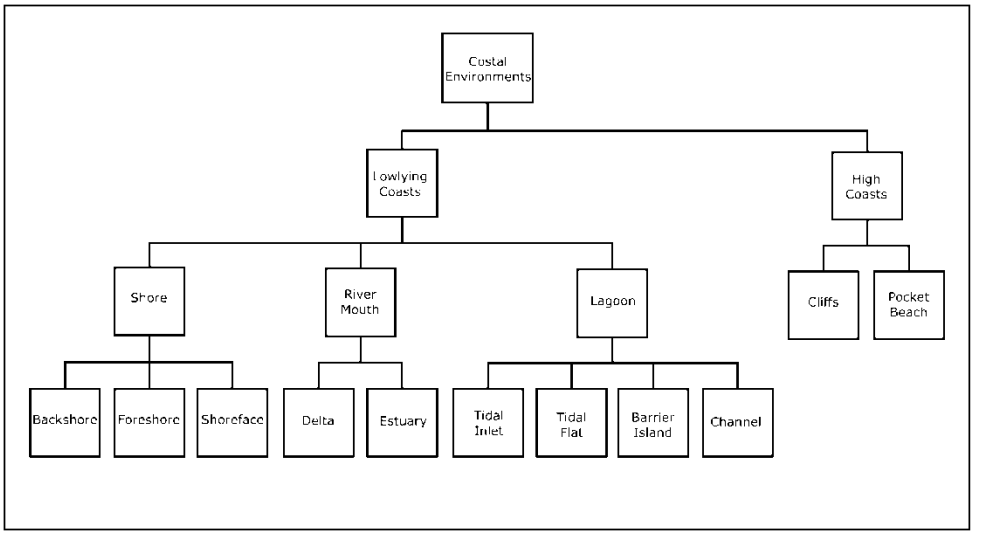

FIGURE 2 Classification of coastal environments. For a brief description of each environment see text.

Backshore is that part above mean high tide and is only influenced by the sea when there are storm waves, or during exceptionally high tides.
Foreshore (or intertidal zone) is the part that is exposed at low water when the tide is out, but covered at high water when the tide is in;
Shoreface (or *inshore*) is the seaward part of the foreshore that is permanently covered by water, except at exceptionally low tides.

Other elements that can be identified within a shore are:

Dunes are ridges or mounds of loose, wind-blown material, usually sand.
Beach ridges are a continuous mounds of beach material behind the beach.
Bar is a submerged or emerged embankment of sand, gravel, or other unconsolidated material built on the sea floor in shallow water by waves and currents.
Beach face is the section of the beach normally exposed to the action of wave uprush.
Berm is a nearly horizontal part of the beach or backshore formed by the deposit of material by wave action. Some beaches have no berms; others can have one or several berms.

3.2 River Mouths (Deltas and Estuaries)

Deltas: from a geological point of view, a delta is an alluvional deposit or a sedimentary body formed by fluvial and marine process interaction. The relationship between fluvial and marine agents determines the development and the shape of the delta itself. The emersed portion is called the plain and forms the continuation of the alluvial plain; the submersed portion includes the shelf or delta front and the foreset going from the coastline towards the sea.

Estuaries are usually defined as that part of the lower river course that is affected by the mixing of salt water and freshwater. The upper limit of water mixing varies with tidal cycle and current, freshwater discharge and the season of the year. Estuaries are regulated by the tides, so that a total redistribution of fluvial sediment occurs by means of tidal flows.

3.3 Lagoons

A lagoon is an elongated body of water lying parallel to the coastline, separated from the open sea by barrier islands, but connected with the sea through tidal inlets. Usually, it lies across the mouths of one or more streams. Lagoons are tide-dominated environments.

A brief description of lagoon morphology follows:

Marshes are islands periodically inundated within the lagoon basin
Barrier island is a bar essentially parallel to the shore, the crest of which is above normal high water level.
Channels and tidal creeks (*gullies*) often represent the remains of an old drainage basin. Channels and tidal creeks are the means by which water masses entering the lagoon through lagoon openings expand.
Tidal inlets are short, narrow waterways connecting the lagoon with the sea.
Tidal flats are marshy or muddy land areas, which are covered and uncovered by the rise and fall of the tide.

3.4 Tidal Flats

These develop on low coasts characterized by high tidal range, abundance of sediments and lower wave energy. Barrier islands delimit them seawards or fare directly to the open sea where wave energy is less; friction determines the large bars. Generally, tidal flats correspond to the intertidal environment.

4 COASTAL ZONE RESOURCES

The coastal zone offers a great variety of resources, both renewable and non-renewable:

(A) *Energy and mineral resources in the continental shelf*:

A1. Mineral resources susceptible to mining operations include: coal (worked underneath the sea floor in Wales since the sixteenth century), petroleum, natural gas, sulfur, tin, sand and gravel, salt (including bromine and magnesium salts-saltpans and desalination brines), phosphorite, barites and heavy metals. Sands can be exploited near coasts for gold, silver and platinum recovery (e.g. Alaska); for diamonds (e.g. Namibia); magnetite, ilmenite, zircon, rutile, chromite (e.g. Australia, New Zealand, Japan); cassiterite (a 75-year old industry in South-East Asia); tungsten, monacite, quartz, limestone (e.g. North Sea, Lebanon, China). Hot brines are potential sources of iron, zinc, copper, bauxite, silver, manganese (e.g. Red Sea).

A2. The economic importance of sand, gravel and coquina has steadily increased due to the demand for building materials where land supplies are depleted or in short supply. Mining must be carefully monitored since it may severely alter benthic life on the seabed, while equilibrium may be endangered. Sea-shell deposits (often exploited for cement) are an important source of calcium, and may be prolific in bays, lagoons and estuaries. Nearshore mining of sand or other minerals can disrupt beach stability and endanger barrier islands, accelerating erosion processes by removing the sand that naturally replenishes beaches. The removal and treatment of all such materials can seriously influence the benthos, filterers, beach stability and water quality.

A3. Lastly, the potential of shelf and estuarine sediments as a source of fertilizers (organic matter, calcium, phosphorus, potassium, magnesium, sulfur and various trace elements) has to be taken into account.

(B) *Seawater* itself is an important resource; in fact, it is used for refrigeration or for human consumption through desalination. Desalination costs remain high, and such operations are economic only where water supplies on land are limited, especially in petroleum-rich countries (Saudi Arabia and Arab Emirates). In other areas, such as the Canary Islands, with a population of 1.5 million and about 5 million tourists per year, desalination is the main source of water.

(C) *Energy resources* (exploiting tides, waves, and temperature or salinity differences).

(D) *Algae, fish and shellfish, mariculture.* The relatively shallow continental shelf is highly favoured for the exploitation of fish, crustaceans and other invertebrates. Consumer fisheries share the markets with industrial fisheries used for animal feed and food industries, ink, glue, and paint manufacturing. Many marine plants are harvested. Coastal zone management needs to protect these activities as long as they remain economically sound.

(E) *Space of prime quality for many human activities* is another important resource of the coastal zone, probably more so than in any other part of the world. This includes space for ports and for communications (roads, railroads, and airports). 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 near harbours and estuaries, because of the increased demand for energy in these areas. The construction of nuclear power plants reflects the need for cooling water.

(F) The coast provides the most sought after *touristic and recreational resources* (beaches, estuaries, zones of high scenic value, and zones of natural interest). Tourism activity flourishes over an ever-increasing mileage. Coastal zones in Third World countries are no exception. The steadily growing demand for tourist facilities triggers the development of coastal accommodation (villas and other buildings, camping grounds, pleasure boat harbours) and also an increase in environmental quality problems. Coastal tourism adds new dimensions to coastal development.

(G) Very often the coastal zone provides (especially in the mid and high latitudes) land with good climatic conditions, gentle relief and good quality soils, ideal for *agriculture.*

5 COASTAL ZONE PROBLEMS

5.1 Natural-Induced Causes

Systematic studies of tide gauge data, climatic change and geomorphological evidence are being gradually correlated to demonstrate that the worldwide rise of sea level in the period 1890–1960 is glacio-eustatic, i.e. related to melting of glaciers, in turn dependent on a rise in mean world temperature by about 1.0 °C.

(1) *Sea level rise* is listed as the reason in a lot of cases, either because no other reason could be given for the erosion on uninterrupted shorelines of extended length or that sea level was known to be rising and, consequently, erosion must be a result.

(2) Another natural reason is *subsidence*, caused by the consolidation of soft materials, such as that which occurs in The Netherlands; the Po estuary in Italy; parts of India; Louisiana, USA, and elsewhere. However, subsidence could also be caused by the extraction of oil

and/or gas as occurs in Japan and in California, and in the Northern Adriatic sea region (Venice). Note that the consequence of subsidence is also a sea level rise.

(3) Some areas may experience *large-* or *small-scale tectonic movements* related to fault lines;

(4) *Tidal inlets* interrupt the normal littoral longshore drift causing erosion because they discharge shore material into the bay and/or into the ocean. Some of these cases are very severe.

(5) *Short-term erosion events* of a severe or extreme nature usually catch the eye of the public. To evaluate occurrences of rapid dune erosion due to storm tides, like hurricanes and typhoons, large-scale experiments are important.

(6) *Siltation* is the settlement of suspended matter, principally of silt and clay size, caused by hydrodynamical conditions, leading to heavy sedimentation. The sediment accumulation causes a reduction in the operational depth of navigation channels and harbours and consequently limits the allowable draft for vessels.

5.2 Man-Induced Causes

(l) *Navigation channels*, like the tidal entrances upon which they were often based, constitute littoral barriers to the normal drift, by accumulating materials that otherwise would drift to down-drift shores thereby contributing to their stability.

(2) *Man-made structures* such as breakwaters, jetties, groynes and other shore-perpendicular structures are also barriers to the longshore drift and have also caused severe damage along downdrift shores. It can safely be said that the protective groynes have caused more erosion than accretion. According to Brutin (1989), man-made structures, are second only to sea level rise as causes of erosion.

(3) For centuries, freedom of the seas prevailed and ocean resources were considered common property. Thus, *mining* was extensively carried out. The last 40 years have seen coastal nations claiming rights to both mineral and fishery resources of the continental shelf.

(4) *Pollution* is possibly from industrial wastes or wastes from harbours released into seawater on the near shore. When these materials are released off shore we are talking about dumping.

(5) *Dumping* is the disposal of waste material such as industrial waste, sewage sludge and dredged materials by transporting them out to sea and releasing them into seawater or onto the seabed.

(6) *Large navigation accidents* involving ships may cause oil spills or pollution from various hazardous materials. The probability of collision or wreck is higher near important harbours, straits (Gibraltar, Sicily Channel) or along the main waterways. Example: swamplands in north-western Brittany, which were destroyed by two major oil slicks caused by the '*Torrey Canyon*' in 1967, and the '*Amoco Cadiz*' in 1978. Other examples are the '*Cavtat*' wreck, in the Otranto Strait (Southern Adriatic) that caused lead pollution and the *Exxon* in the Ligurian Sea.

5.3 Tourism

Tourism is operationally ambiguous. On the one hand, it denotes an enormous and fragmented global industry providing a wide range of services and products, to tourists. On the other hand, the term is also commonly employed to mean travel for pleasure.

Second, tourism is omnipresent, directly or indirectly involving a huge number of people around the world.

The World Travel and Tourism Council's (WTTC) economic report for 1992 estimated tourism's gross output (i.e. worldwide spending for tourism services including domestic and international travel) for 1990 at 2.9 trillion U.S. dollars, which represents 12–13% of the world's consumer spending and associated with the creation of 5–7 million jobs (6.5% of the global work force). Investments represent 6.7% of the worldwide capital investment. Tourism can have both beneficial and detrimental effects on environments.

Benefits or positive effects:

(1) conservation of natural resources has emerged as a positive aspect of tourism development. The anticipated economic returns from tourism provide a community incentive to conserve the resources upon which its tourism industry depends.
(2) Equally important, the growing awareness of the connection between quality environments and sustained tourism has prompted many governments to manage specific natural areas for tourism and recreation.
(3) Tourism can also provide a catalyst for heightened environmental consciousness. Meaningful encounters with the natural environment motivate tourists to actively lobby, upon their return home, for increased protection of endangered species and threatened ecosystems (an entire specialization within the tourism industry has evolved from this concept of 'ecotourism'.

Detrimental or negative effects:

(1) the sheer numbers of tourists who visit a natural area can impact the quality of that environment: grasslands can be crushed, hiking trails and sand dunes eroded, coral reefs trampled and broken, and animal cycles disrupted.
(2) Dense building along the coastline can contribute to aesthetic degradation of the coastal zone.
(3) Runoff from land-clearing activities related to development can enter riverine and nearshore ecosystems, increasing turbidity and decreasing photosynthetic processes. High nutrient loads from runoff can cause nutrification, which results in algal blooms.
(4) Boating and organized cruises are increasingly popular tourism activities. Tourism destinations as remote as Antarctica are now at risk from vessel-generated pollution.
(5) Contrary to the popular myth, tourism does consume natural resources, souvenir collection of shells and corals by tourists and others consumes valuable resource amenities.
(6) Hunting, sport fishing and spear fishing activities can also impoverish resource stocks.

6 OCCUPANCY OF COASTAL ZONE AND ABUNDANCE OF RESOURCES

The abundance of resources has traditionally attracted, and will increasingly attract, a very large proportion of the human population to coastal areas. The trend towards a marked increase in population in these areas applies globally, and it is expected that by the end of the century about 80% of the world's population will be concentrated in a fringe some 50 km wide along the coasts.

The shift of population, which is presently taking place, is comparable to the one from rural to urban areas, which happened during the first half of the last century in industrialized countries. This transfer of population relates to the search for better living conditions. During the last few decades, coastal zone occupancy and use have taken place in many parts of the world in a spontaneous and anarchic manner, with little concern for the conservation of the

environment which is being used and with practically no integrated planning at the national or, even less, international level.

There is, therefore, an urgent need to manage littoral zones carefully and to preserve a series of littoral units and ecosystems, many of them fragile and unique and often constituting public property, and often with a high potential for recreation and other public uses. Spain offers a clear example of this. Most of the coastlines along the Mediterranean or around the Canary Islands are nearly continuous strips of buildings, which in many cases has produced very serious impacts and the irreversible destruction of valuable environments.

The activity which takes, by far, the biggest share of the coastline in European countries is tourism (practically the total length of the coast in Italy and Germany; 65% in Spain; about 75% of the 'usable' coast in France and 55% in Denmark) and many kilometres of coastline are added each year for tourism activities in many developing countries, mainly the ones with Mediterranean and tropical climates.

The intense occupancy is bringing about a wide range of problems:

(1) Landscape deterioration in scenic coastal tracts.
(2) Anarchic tourism development.
(3) Un-regulated urban-industrial developments, often combining with each other or with tourism, or even occupying prime agricultural land.
(4) Damage or destruction of habitats of several species.
(5) Interference of coastal works with sediment transport processes.
(6) Destruction of valuable, sensitive and endangered environments such as: dune fields and coastal barriers (through building and over use); estuaries, intertidal areas and coastal wetlands (through filling, draining and reclamation); deltas, reefs, mangroves, algal prairies, and sandy coasts.
    The destruction of estuaries, intertidal areas and coastal wetlands represents the major ecological loss, as these are zones of extremely high productivity and essential for the reproduction and nourishment of many species of commercial interest. Perhaps as many as 50% of these species spend a part or even the whole of their life-cycles in these zones.
(7) Pollution of coastal waters and sediments, especially in estuaries and near harbours. This pollution is sometimes 'natural', but normally it is directly produced by humans.
    – pollutants carried down by rivers (agrochemicals, urban and industrial waste, sometimes including heavy metals, e.g. Hg–Cd contaminations in Japan);
    – direct dumping of urban and industrial solid and liquid waste;
    – pollution due to the extraction, transport and handling of hydrocarbons;
    – pollution from harbour operations;
    – pollution carried from the atmosphere by rainfall (sulfur compounds).
(8) Dumping of dredging waste.
(9) Refrigeration waters from power plants (nuclear and conventional) and industries.
(10) Red tides and other biological (natural and man-induced) pollution.
(11) Mining waste from both on-shore and off-shore operations.
(12) Incidence on the population of a considerable variety both natural and technological hazards:
    – floods in the lower courses of rivers (Liguria);
    – storm action over coastal constructions and buildings near the coastlines;
    – slides and related falls in cliffs and other slopes;
    – earthquakes and tsunamis;
    – subsidence of unconsolidated materials;
    – coastal erosion;

– general rise of sea level;
– volcanism;
– large navigation accidents.

7 ACTION PLAN

To try to present a complete action plan to tackle all the situations would be pretentious and unrealistic. Nevertheless, some necessary tasks can be pointed out.

Appropriate use and management must be based on a good knowledge of the coastal zone. Therefore, there are two main areas of action: research and planning legislation and management.

7.1 Research

Research must be multidisciplinary. The cooperation of the natural (physico-chemical, geological, marine) and social sciences and engineering is essential for a good understanding of the complex problem involved.

The research should provide a quantification of processes and phenomena, in terms of space and time parameters (rates of transport, sediment loads, rates of erosion–accretion, biomass productivity, surfaces affected by different processes, response time to changes in the environment, etc.)

Examples:

(1) Inventory and characterization of the units that make the coastal fringe and of their resources, including a diagnosis of their present state.
(2) Inventory of elements and sites of natural, scientific, historical or cultural interest.
(3) Analysis of natural hazards, identification and zoning of affected areas, determination of periodicity as well as hazards and risk levels and design of preventive measures.
(4) Analysis and quantification of active processes (sediment transport, fluvial discharges, transport and fixation of pollutants, nutrient fixation and production of biomass, coastline variations (long, medium and short term).
(5) Study of relationships between organisms and abiotic factors in different environments.
(6) Analysis of sources, transport mechanisms and rates of accumulation of pollutants in soils, waters, sediments and organisms.
(7) Investigation and evaluation of mineral and energy resources, and determination of priority areas for their exploitation.
(8) Analysis of the existing trends in the flows of population and capital and their causes, as well as of the main socio-economic problems in each region.

All this means the production of maps, which constitutes a necessary first step towards sound land use planning.

7.2 Regulations and Management

In the field of planning, regulation and management the following tasks should be carried out:

(A) Conservation and protection of fragile and/or rare environments through legislation, with special attention to estuaries, wetlands and dune fields.

(B) Promotion of non-destructive uses of the coastal zone, in order to maintain its export potential on the basis of the quality (regulated tourism development, educational and recreational uses, establishment of natural parks, etc).
(C) Gradual elimination of waste disposal operations.
(D) Setting up protective measures against erosion in critical areas, including beach and dune stabilisation actions. The measures to counteract erosion range from the pure and simple retreat '*Letting the nature follow its course*' (recent example: The Netherlands), to hard methods such as the 'stand by' (construction of breakwaters, aprons, etc.), passing through softer methods ('give way') like beach nourishment, installation of artificial algal reefs, etc.
(E) Determination of areas, on- and off-shore, where exploitation of mineral resources (especially, sand, gravel) can be allowed, and regulation of these operations.
(F) Planning and development of mariculture, algae harvesting, etc.
(G) Determination and regulation of acceptable fish catches in the different fishing grounds.
(H) Evaluation of natural hazards and organisation of preventive and corrective actions to minimize damage.
(I) Preservation of high-quality soils for agriculture.
(L) Development of programmes for the information and education of the public, in order to create a general awareness of the need to protect this vital and delicate zone. In general to draft and implement a coordinated interstate policy of research, planning and management of the coastal zone – Example: take into account the CZMA of US.

8 RESOURCE INVENTORY AND ANALYSIS

Land use inventory	Commercial (business, hotels, light industry, fisheries)
	Industrial (shipyards, factories)
	Extractive (sand and gravel pits, gas wells)
	Institutional (schools, offices)
	Military
	Transportation (highways, railroads, ferry terminal, bus)
	Residential
	Public Access Recreation
	Open Space (undeveloped land)
	Agriculture (cultivated land)
	Marsh
	Managed wetlands
Land use analysis	Population
	Minimum development
	Hazard-security
	Accessibility
Natural resources	Shoreline characteristics: beach, cliff, marsh, etc.
	Hydrological feature (river, lagoon, pond)
	Vegetation (higher value for native species), marsh, grassland, urban vegetation
	Wildlife (fishing sites, shellfish habitat, rare and endangered species habitat)
	Climate (high wind exposure, fog incidence)
	Special features (fault, tsunami hazards, subsidence, flood hazards)

Natural resources analysis criteria	Accessibility
	Interest
	Fragility (marshes, rare species habitat)
	Hazard (sites that lie in active fault zones, or susceptible to floods, tsunami, subsidence or landslides)
Visual resources	Entrance view (significant first view)
	Landscape features
	Panoramic view and quality of view

Recommended Bibliography

This short note is but a very brief review of coastal zone management and related problems, and the remarks stated above are far from being sufficient to provide an overall picture on the matter. Out of the vast literature on the topic, I highly suggest reading the following publications, which represent the mainstay to this manuscript.

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