Integrated Coastal Zone Management (ICZM): a framework to tackle environmental issues? Danish Approach

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1. INTRODUCTION

> 'Coastal zones are a well-chosen test site, because so many interests occur. So, can we succeed in the coastal zones, we can succeed anywhere'. (Klaus Bakdal, Stevns Municipality, Denmark)

If we go beyond the basic definition that coastal area is the place where land and sea meet and interact, the complexity of this zone may rapidly become overwhelming.

So how to understand it?

The Integrated Coastal Zone Management concept is not something broadly known among the common population. But it is definitely a framework appraised among the scientific community and many international organisations (OECD, EU…).

That is why the purpose of the project turns to be an assessment of the value of the ICZM. What could we get from the ICZM in our attempt to understand the coastal areas, their functioning and their problems ?.

Consequently, in our analysis of the ICZM two steps have been required.

First, we have gone through a deep work of research to catch what was the ICZM concept and it has seemed that it was more than a general set of guidelines. Many things are related to ICZM and need to be taken into consideration to understand ICZM.

- ICZM gives a complete and realistic definition of the coastal areas.

It helps us to realise that coastal areas have to be managed as a broad and extended ecosystem.

The concept of Integrated Coastal Zone Management is based on the general system theory. It is a holistic and multidisciplinary approach covering the full cycle of information collection, design of planning,

management and implementation. It is also iterative and dynamic: the cycle has to be resumed all the time as coasts change and need other measures to be taken.

The general theory system applied on management states the integration of objectives under one holistic ecosystem based approach. A special importance is being given also to the external environment, as the coastal system is included in more comprehensive systems by natural cycles as well as by legal and political subordination. In this non-structuralist approach, coastal changes are more important then the detailed structure.

- ICZM gives also a clear idea of the values of the coastal areas.

Coastal environment has a rich and original biodiversity, but comprises also recreational and aesthetic values.

It consequently shows that coastal zones are subject to many interactions and underlines the high need of integrations.

The coastal resources are very much exploited by different sectors of human activity both traditional, such as coastal fisheries, aquaculture, forestry and agriculture, and modern for instance marine transport, industry or tourism.

All human driving forces of the coastal areas as well as the natural ones interact in different ways there are ‘productive’ interactions (synergistic and complementary) but also ‘critical’ interactions (competitive and antagonistic). A good management of the coastal area, based on a systemic and holistic view, will aim at maximising the first ones.

- Then the ICZM has its own entity. It encompasses different dimensions. Meanwhile the integration is horizontal (cross-sectoral) and a vertical (at various administrative bodies), as well as territorial

(comprises a delimitated space) and through time (it is long-term oriented). The public awareness and participation is needed.

The ICZM is a framework, a process which leads to action; it prescribes behaviour, but has to be adapted to specific situations. Consequently the ICZM approach differs very much. ICZM is at different stages of implementation in many states of the world and it is widely accepted as the proper way of managing the complex coastal zones.

Second, in our attempt to test the efficiency of the ICZM, we had to apply the knowledge we got from the ICZM to a practical case. We have chosen Denmark.

Denmark is the European country with the longest shoreline relative to the size of its territory. Its low and flat landscape greatly shaped by the sea and the long tradition in managing the coastal areas make Denmark an interesting study case for the development of the ICZM.

In the practical analysis, we have chosen three Danish environmental issues (Eutrophication, Sea-level rise and Marine and Coastal pollution). Then, we have analysed them in the perspective of our "ICZM knowledge" in order to pinpoint the successes and the failures of the Danish coastal management.

Finally, this project tries to analyse the ICZM concept in a theoretical way. It shows how far it can help us to understand scientifically the coastal areas.

But this project wants also to assess the practical efficiency of the ICZM to understand environmental problems and to solve them.

2. COASTAL AREAS – A SYSTEM OF INTERACTIONS

2.1.Coastal zone: definition, limits and characteristics

Coastal zone is a term used to define a transition zone between terrestrial and freshwater ecosystems and the marine ecosystem. These is strictly from the natural science point of view, but actually besides the natural driving forces, the human presence and activities has a more and more dominant role in the coastal areas and should be included in a definition.

Actually there is no rigid definition of the coastal zone, as boundaries quantifying driving forces depend on the specific driving force in question and how it interacts with others in the system.

Nevertheless the coastal zone can be defined as:

'The interface where the land meets the ocean, encompassing the shoreline environments as well as adjacent coastal waters[…].For planning purposes the coastal zone is a special area, endowed with special characteristics of which the boundaries are often determined by the specific problems to be tackled' (World Bank, 1993)-(Connolly-2001)

The coastal zone consists of two parts- a terrestrial area and a marine area which influence, meet and interact. There are connected to each other both in terms of nature and landscape but also in land use and administrative units (local and regional authorities).

A coastal area is by itself not a line, but a *band* in terms of:

- the nature of environment;
- the interactions of marine and coastal processes;
- management needs.

This complex system develops on two axes: - one parallel to the shore (longshore) and the other perpendicular to the shore (on/off shore). (OECD, 1993)

For the first axis there is relatively little controversy about the definition since it does not typically cross environmental systems boundaries-except for the watersheds.

For the on/of shore axis there is considerable discussion. The inland definitions range from those that include entire watersheds to others that include only the immediate strip of shoreline adjacent to the coast. The extension of the seaward limit can reach as far as a country jurisdiction.

These controversies complicate things both for scientists who want to establish precise defined areas for ecological analysis and for managers who want well-defined legal boundaries (ibid.)

As a general rule, coastal zone management should be based upon an *ecosystem approach*.

The ecosystem approach is defined as an 'analytical management approach which seeks to consider explicitly the physical, chemical and biological interactions among the various components of the system in relation to natural and anthropogenic both input in the system and withdraws/outflows from the system '(ibid.).

Such an approach implies that the on/off shore axis should include also 'the associated aquatic ecosystems and those portions of the tributaries draining into the estuary up to the historic height of migration of the fish to spawn or historic head of tidal influence' (Hildebrand, 1989)

The coastal zone seldom corresponds to already existing administrative and planning units, although the natural coastal systems and the area in which human activities involve the use of coastal resources may extend well beyond.

Indeed in the Land Ocean Interactions in the Coastal Zone (LOICZ) definition, coastal zone is the area between 200m above and 200m bellow

sea level. If we accept that, the whole country of Denmark, for example, is a coastal area. (Connoly, 2001).

All these discussions about delimiting for a more effective management demonstrate that coastal areas are really valuable both environmentally and economically.

2.2.The value of the coastal area:

2.2.1 Environmental value of coastal areas:

Coastal areas provide a great number of environmental goods and services. Their ecological importance is being widely accepted whether we take a more utilitarian or a more 'environmentalist' approach.

The main characteristic of the coastal ecosystems is its dynamic nature resulting from the transfer of matter, energy and living organisms between land and sea, under the influence of primary driving forces such as: weather and climate, sea level rise and tides.

Marine, estuary and coastal areas often have nutrient-rich water because both flows from the land and also ocean upwelling. The tendency for them is to have high biological productivity (FAO, 1998). Moreover coastal areas often contain critical terrestrial and aquatic habitats: estuarine areas, coral reefs, coastal mangrove forests, coastal wetlands, tidal flats, sea grass beds etc.

They comprise unique ecosystems and support a rich biodiversity.

'It is estimated that 90% of the world's fish production is dependent on the coastal areas at some time in their life cycle.' These areas support numerous migratory and non-migratory waterfowl and shorebirds.

Maintaining the biodiversity is widely accepted as an imperative of our times. (v. 1971 Ramsar convention)

Physical features of the coastal ecosystems, such as belts of mangrove, can mitigate the effect of:

-Natural disasters such as storm-tide surges, shoreline retreat or floods;

-Natural processes such as coastal erosion, land accretion, damage from wave or wind action.

Even when the coastal ecosystems are not unique biological systems, their location at the sea-land interface makes them valuable from the recreational and aesthetic point of view. They support tourism activities and provide attractive sites for residential areas and industrial development.

2.2.2.Economic value of coastal areas

The coasts are areas of convergence of people and human activities. Historically, coastal areas have been a major habitat for humans due to the favourable biophysical and climatic conditions, together with the ease of communication and navigation. Nowadays, although coastal zones occupy less than 15% of the Earth's surface, they accommodate more than 60% of the world's population. If the trend continues, by 2025 there could be up to 75% of humanity living in coastal areas. (UNCED, 1992) (European Environment Agency, 1999)

Harbours, that have always been nuclei for development in the past, have an ever-growing importance today. Traditional resources based activities, such as coastal fisheries, aquaculture, agriculture or forestry are now being competed by activities such as shipping, industry or tourism.

From the social and economic point of view, coastal areas importance is indubitable as coastal resources support key economic and subsistence activities. These resources permit the development of agriculture, fisheries, forestry, mining, oil and gas extraction, marine

transport (80% of the world's cargo is presently shipped across the oceans and along the coasts) or tourism (European Environment Agency, 1999). Many of the world's most productive agricultural lands are located in river deltas and coastal planes.

In future the dependence on coastal resources is likely to remain strong in the conditions of urbanisation and economic diversification (mostly in the developing countries). Industrial development often entails the processing of agricultural, fishery and forestry products, together with oil refining and textile manufacture. These diversified economic activities are often also dependent on coastal resources and, as economic diversification increases and makes the component sectors more interdependent, conflicts over natural resources and the environment will tend to develop.

These conflicts already exist putting a lot of pressure over the coastal fragile environment and the threats have already become, in some areas complicated environmental issues.

2.3. Interactions in the coastal areas

A global study of the coastal zone and its interactions it's a real challenge as coastal processes respond and interact with local as well as with global drivers.

Among what may be considered as global factors affecting coastal areas we can count: climate change, international trade and development and mass tourism (Smith, 2003).

There are also many other factors all assuring intense and sustained environmental pressures on the coastal areas. The local geomorphology as well as the way coastal societies manage the coasts determines responses to these. In the coastal areas local and global interact as well as land and sea and it's very difficult to take into account all the dynamic

interactions which take place. A structural approach in management is suited only if we have also a holistic view.

The coastal system is interdependent and interrelated and has direct and indirect connections with the external systems inland and offshore. For example, fish may be dependent on the mangrove swamps as the habitat for juveniles, or the coral reef may be related to the filtering properties of the mangrove, so that only clean water reaches the reef. Conversely, if the silt from soil erosion covers it, a coral reef could die. The soil erosion could be, maybe, accruing many miles upstream, caused by inappropriate forestry and agriculture practice. Coastal reefs, dunes and mangroves may protect coastal agriculture from soil erosion or storm surge. (FAO, 1998)

If the economic development is not well managed it can create serious problems related to water pollution, degradation of critical habitats, depletion of natural resource stocks etc. The publicised benefits in increased employment and rising incomes will be undermined by the costs of health, productivity and aesthetics. (Idem)

All economic activities consist in changing resources or inputs in products or services. Subsequently, all activities will affect and interact with their environment, whether it is ecological, economic or social. Such interactions can be categorised as being: **synergistic, complementary, competitive** and **antagonistic**:

- The activities are **synergistic** when their interaction results in an increase in whether economic activity or environmental benefits greater than the sum of their individual results. For instance, tree conservation on a land used before for agriculture in a coastal area will provide wood, stabilise the soil preventing erosion and slides , lead to

a more rational and complete use of soil fertility, enhances the relations between species, diversifies economic opportunities;

- Two activities are **complementary** when they share the same resource(s) or facility without conflict and when one activity provides inputs to the other. For example when forest industry supplies timber for boat building or when agricultural by-products are used in cultured fish feeding.
- A **competitive** interaction is when the activities have a shared requirement for a limited supply of resources, resulting in conflict. The competitive interactions can be either *reciprocal* or *one-sided*. A ***reciprocal*** *competition* is, for instance, when farmers and urban dwellers use the same groundwater supply, suffering from shortage of water or its increasing salinity. A ***one-sided*** interaction is for example where water is used for irrigation upstream, affecting the flow downstream and consequently damaging fishery habitats.
- An **antagonistic** interaction exists when the output of one activity degrades the resources or modifies the environment harming another activity. For instance, pollution from urban, industrial or agricultural activity can affect fisheries by killing fish, destroying fish habitats, infecting them with substances harmful for human beings. The antagonistic interaction can also be reciprocal when the degradation or vanishing of the resource(s) ends for the former harvesters with the loss of livelihood.(FAO,1998)

A systemic and holistic view of managing the coastal area will aim at maximising synergistic and complementary interactions and minimising competitive and antagonistic ones.

2.4. Environmental problems

There is a big pressure on the coastal environment coming from both natural and anthropogenic driving forces that, as shown before, interact in various ways.

Coastal areas' dynamic nature results from the exchange of matter and energy between land and sea. We will concentrate on some of these specific coastal environmental issues having in view the idea of interdependencies mentioned before.

The natural processes such as the dynamics of alluvia and natural sedimentation which determines nutrient and energy flows are being modified by human activities. They affect water flows by constructing dams, extracting water or deviating rivers. They also affect erosion especially by deforestation. . The reducing or blocking of sediment supply can slow down the vertical accretion – aggravating salt-water intrusion problems. By the other hand it can give rise to the retreat of the coastline through wave erosion (FAO, 1998). This is the case of the Romanian coasts at the Black Sea affected by erosion because of the hydropower plants on the Danube which block sediments from the sea water.

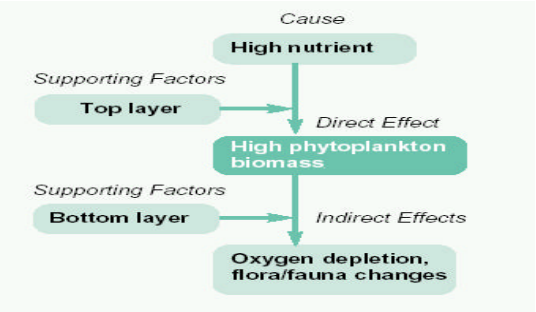
2.4.1. Eutrophication[1]

Eutrophic means nutrient-rich and eutrophication literally means enrichment with nutrients, although nowadays the term is more often used in a negative sense to mean over-enrichment. Indeed in addition to carbon, oxygen and hydrogen that plants can find directly from water and carbon dioxide in the atmosphere, two major nutrients are necessary for

[1] **As eutrophycation is one of the most representative environmental issues in the coastal areas and we will focus on that in our study case on Denmark we consider necessary a more detailed approach on explaining the process.**

the development of aquatic life: Nitrogen (N) and phosphorus (P). A third one, silica (Si), is necessary for the development of diatoms. Natural eutrophication is the process by which water body is gradually getting older and become more productive. It normally takes thousands of years to progress. But the presence of excessive nutrients can seriously disturb this natural eutrophication process and the functioning of marine ecosystems and humans, through their various cultural activities, have greatly accelerated this process.

The typical scenario leading to eutrophication is the following (FIG. 2):



Eutrophication has many implications for coastal ecosystem.

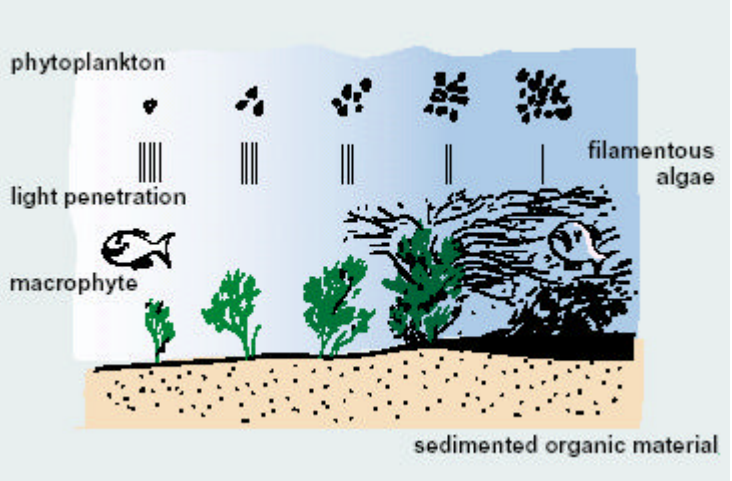
Under normal conditions – without the eutrophication, macrophytes at the bottom of the water develop normally, the amount of phytoplankton is such that light can penetrate down to the bottom and fish and shellfish can live and reproduce. If the amount of nutrient increases, mainly short-living macrophytes (for example: pelagic macroalgae) will grow much faster and larger and new species will develop. These will compete with those (for example seagrasses or benthic plants) originally present. In some cases phytoplankton will also multiply. This development of macrophytes, including free-floating algae, and phytoplankton will prevent a large proportion of the light from reaching the bottom. The first signs of the reduction of oxygen concentration will become visible.

Indeed the oxygen content of bottom waters is determined by the balance between supply and consumption. Oxygen is transported to the bottom areas primarily through mixing with surface waters, or via inflow of bottom waters from other areas. Oxygen is consumed in the respiration of living organisms and the decomposition of organic matter.

During periods of limited supply and large consumption, oxygen depletion may occur. Eutrophication leads to increased oxygen consumption, and therefore increases the risk of oxygen depletion. If the oxygen is completely exhausted, hydrogen sulphide is formed. (The presence of hydrogen sulphide is sometimes referred to as a negative oxygen level.) Oxygen depletion and, even more so, the presence of hydrogen sulphide constitute a serious threat to the bottom fauna. The risk is greatest in the deepest sections of water.

When the situation become extreme, oxygen concentrations will reach levels that make aquatic life impossible. Only those species that require very little oxygen will survive on these conditions. The amount of organic sediment will increase, as will the demand in oxygen. The final step will be the end of all aerobes.

The figure [3] below illustrate the eutrophication process:



(FIG.3 Miljoministreriet, 2001)

The major consequence of eutrophication concerns the availability of oxygen. Plants, through photosynthesis, produce oxygen in daylight. On the contrary, in darkness all animals and plants, as well as aerobes and reducers, respire and consume the oxygen. These two competitive processes are dependent on the development of the biomass. But short-lived algae may die and sink to the bottom of the sea, where their decomposition uses up oxygen. In the case of severe biomass accumulation, the process of oxidation of the organic matter that has formed into sediment at the bottom of the water body will consume all the available oxygen. Thus, the water will loose all its oxygen and all life will disappear. This is accompanied by specific smell of rotten eggs.

In parallel with these changes in oxygen concentration other changes in the water environment occur:

Changes in algae population: During eutrophication, macroalgae, phytoplankton (diatoms, dinoflagellates, chlorophytes) and cyanobacteria, which depend on nutrients, light, temperature and water movement will experience excessive growth. From a public health point of view, the fact that some of these organisms can release toxins into the water or be toxic themselves is important.

Changes in zooplankton, fish and shellfish population: When eutrophication occurs, this part of the ecosystem is the first to demonstrate changes. Being most sensitive to oxygen availability, these species may die from oxygen limitation or from changes in the chemical composition of the water such as the excessive alkalinity during intense photosynthesis.

Being the result of a natural process, eutrophication remains above all the consequence of human activities. Indeed as we will see it later [5.1.3.1.], Agriculture may be the main cause of nutrient adding in watercourses and consequently the main cause of eutrophication.

2.4.2.Sea level rise

So called, natural threats for the coastal zones are also tidal surges and **sea-level rise** (FAO, 1998), which sometimes are interrelated as shown below. Sea level rise is a 'natural process' as greenhouse gases – mainly CO2 emissions –. Indeed the consequent climate change caused by human activities contributed to the melting of the glaciers and, finally to the sea level rise.

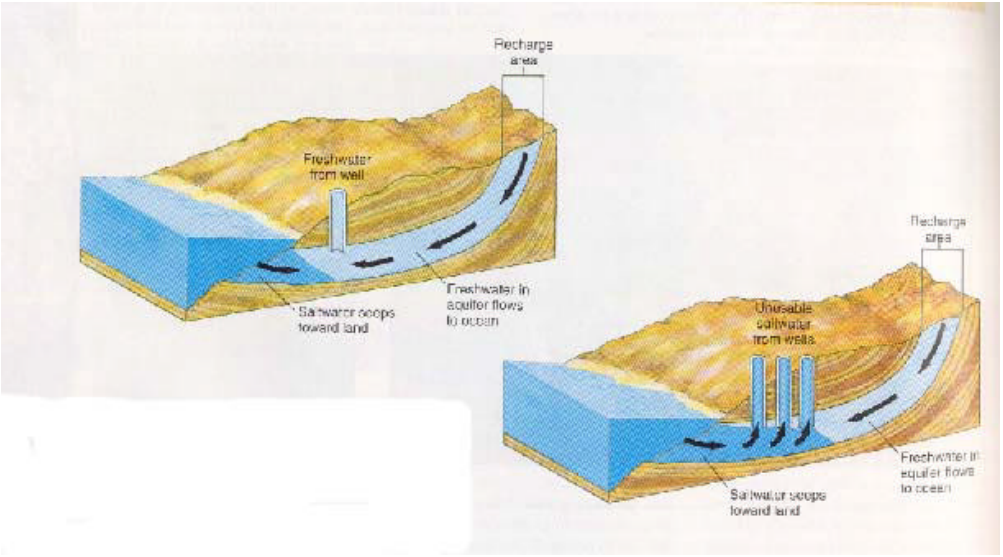
The most serious impacts of the sea level rise identified at the meeting 'Global and regional sea-level change and hydrological changes', - Lori-Porto San Paolo, Italy, 4-6 October, 1999(Sahagian, 1999)-are:

-*Shoreline erosion*- mostly of the beaches – is because the equilibrium profile is maintained in the coastal zone. The coasts will respond to the sea level rise by inland erosion thus extending the region of impact. Nearshore topography is important for the local authorities to be able to predict the impact of the shorelines on local coastal area.

-*Exacerbation of storm wave damage,* particularly during high tides is related with sea level rise.

-*Coastal ecosystems* loss as they are subject to flooding and cannot keep pace with rapidly rising sea level rise and they are drowned. Humans try to artificially maintain the existing equilibrium profile with defences (seawalls, levees etc.).In some of these cases ecosystems can be completely lost, as they cannot migrate landward.

-Aquifer salinization is a serious problem as o significant part of the world population relies on groundwater drawn from coastal aquifers for fresh water supply. The water supplies can be salinizated as the sea level rise and the depth of the freshwater lens in the coastal zone is reduced (Sahagian, 1999). In extreme cases exacerbated by over pumping, the aquifer may rapidly become unsuitable for drinking, irrigation and even industrial use (Fig. 4).



(Fig.4 Saltwater intrusion- Enger and Smith, 2002)

2.4.3. Coastal pollution

A large amount of substances, which are harmful for the environment, are flowing into the sea mainly originate in human activities from everyday housekeeping to agriculture, industry, traffic and energy production.

There are two main types of sources:

- Point sources when the pollution is from particular sites (e.g. discharges of wastewater from sewage treatment plants and industry, oil spills, sea farms);

- Diffuse sources when the pollution is either leaching from the land (e.g. nitrates from the cultivated fields) or consisting of atmospheric fallout (e.g. substances in chimney smoke are bound to dust and sooner or later precipitate)

Many of these substances are innocuous in the environment being degraded by micro-organisms and other natural processes. However, they can disturb the balance between different animal and plant species. Other substances only degrade with difficulty and can harm coastal life in general.

The most dangerous substances that have to be monitored are for instance heavy metals and poorly degradable organic substances such as PCBs (polychlorinated biphenyls), pesticides, softeners for plastics, TBT (tributyltin) and the PAHs (polyaromatic hydrocarbons). (Miljøstyrelsen, 2001)

Heavy metals occur naturally in the environment. Such an occurrence is called background level. The background level is exceeded when the heavy metals contaminate the sea through atmospheric fallout and discharges from urban and industrial area. After contamination, most of the heavy metals are incorporated into particles of the sediments. A small quantity is dissolved into water and can spread in coastal food chains. Mercury and cadmium are heavy metals that accumulate in this way. They are very toxic both for humans and other organisms. (Idem.)

PAHs are substances that are formed during the combustion of fossil fuels (oil, gas and coal). The main sources of PAHs in the coastal environment are oil spills from shipping, oil extraction and spillage from industrial activities. Some of the PAHs are very toxic to coastal and marine organisms and others can act as carcinogens causing changes in the genetic material of man and animals. However, most of the organisms

metabolise the substance and eliminate them. This limits the accumulation in the food chains.

The environmental issues shown before are related one way or another to human activities which. They are dominant in coastal areas where man's presence is more and more acute. The Coastal Human Pressure Indicator (CHPI), estimating the number of the world inhabitants per km of coastline shows an increase from 6300 inhabitants per km at the beginning of '70s to 9000 inhabitants in the early '90s and to 10 000 at the beginning of the 21st century. (OECD, 1993). Since these are areas where people want to live and work and where recreational activities have an important place- coastal zones face pressure from development. The rapidly increasing pressures on the coastal zones give rise to many conflicts among both traditional resource users and the 'newcomers'. The concern is that the ones who enter the scene will diminish the resources. The environmental concern is expressed in terms of protecting stakeholders' interests in resource use and not the environmental protection itself. (Rosenthal, 2000)

A way of managing the coasts, which encompasses both all stakeholders' interests and the integrity of the coastal ecosystems, is needed.

3.THE WAY TOWARDS INTEGRATED COASTAL MANAGEMENT

3.1.The need of integration:

Coastal areas are dynamic systems, rich in terms of natural resources and, consequently, in human activities. The coastal zone is also, as shown before, susceptible of potential unsatisfactory interactions and outcomes, both economically and environmentally.

Considering, the ever increasing pressures on natural resources and unacceptable damage to coastal zone systems, it is obvious that more and more environmental problems in coastal management will be attributed to a lack of integration of the above mentioned interactions (OECD, 1993). This includes basically a systemic view of the coastal zones.

It has become clear that the natural processes of the coastal zone are also being affected by activities far from the coastal zone itself. For example, the industrial discharges into inland watercourses are affecting the water quality in the coastal zones (Idem). This highlights the importance, on the one hand, of integration of the coastal management with the management of other sectors of the economy and on the other hand the integration at the international level in respect of transboundary issues.

If we take only the economic point of view, integration can also be given a sound economic rationale. The externalities abound in the coastal areas. Usually, there is little incentive, for example, for the farmers to consider the impacts of agricultural activities on water quality, or for those involved in aquaculture the impact of it on tourism (Rosenthal, 2000). So there is first an economic justification for an integrated management of the interactions between competing activities and balancing the interests of the different stakeholders in the coastal areas.

The different users should be made aware of the impact their demands on coastal resources may have on other users. This could be done by the use of instruments that influence their economic behaviour towards resource use (OECD, 1993) and also by involving all of them in the process of policy formulation and management (Govan, 1995) in a co-ordinated way.

Looking from the economic point of view, we should remember that integration is not an end in itself. We have to take into account the costs of achieving it, even if it is technically feasible. The economic imperative of integrated coastal zone management is providing the best use of coastal resources in the least costly way. (OECD, 1993)

Looking from both the environmental and economic point of view, the dual role of regulatory and economic instruments to enhance resource management has to be assessed. The complementarity of the two is essential in understanding the pros and cons of the integrated coastal management.

3.2. Environmental management models

The integration can be a good choice in solving certain economic and environmental coastal issues. However it is not an end in itself and can be challenged as a choice. Still choice is made; the issues exist and have to be handled by managers. This is possible only by understanding the functioning mechanism of managing the coastal areas.

OECD and United Nations Commission have devised models that could help understanding and tackling the rising environmental issues in the coastal areas.

3.2.1.Pressure-State-Response Model (P-S-R)

P-S-R model was popularised by OECD (OECD, 1993) as a common framework to evaluate the human action concerning environmental issues. This model simplifies the environmental problems and solutions into variables that stresses the cause and effect relationships between the different kind of human *pressure* on the environment, the *conditions* of the environment and society's *response* to the condition.

Water quality is a major environmental concern in coastal areas. It has been used as an example to display the three types of indicators. The 'pressure' on the environment is measured by the tons of fertilisers used by waterfront property owners. The 'state' variables monitor the condition of the environment. In our case, the actual nutrient dynamics of the water body would serve as the state indicator. The 'response' indicator measures the actions taken to reduce the pressure or to improve the state of the water, in our case. (Bowen, 2003)

The P-S-R approach emphasises the need to focus on those factors mostly influencing environmental systems and on the associated consequences –in terms of environmental conditions and regulatory change.

The limitation on this approach is obvious. It is by far too simple in its view and too narrow in its scope. Nevertheless, it is a good start in understanding anthropogenic environmental problems and how to deal with them.

3.2.2. The "driving forces-pressure-state-impact-response" model (D-P-S-I-R)

One of the weak points of the P-S-R model is that it focuses on anthropogenic pressures and responses, but does not take into account the natural causes of the pressures. Natural variability and episodic events

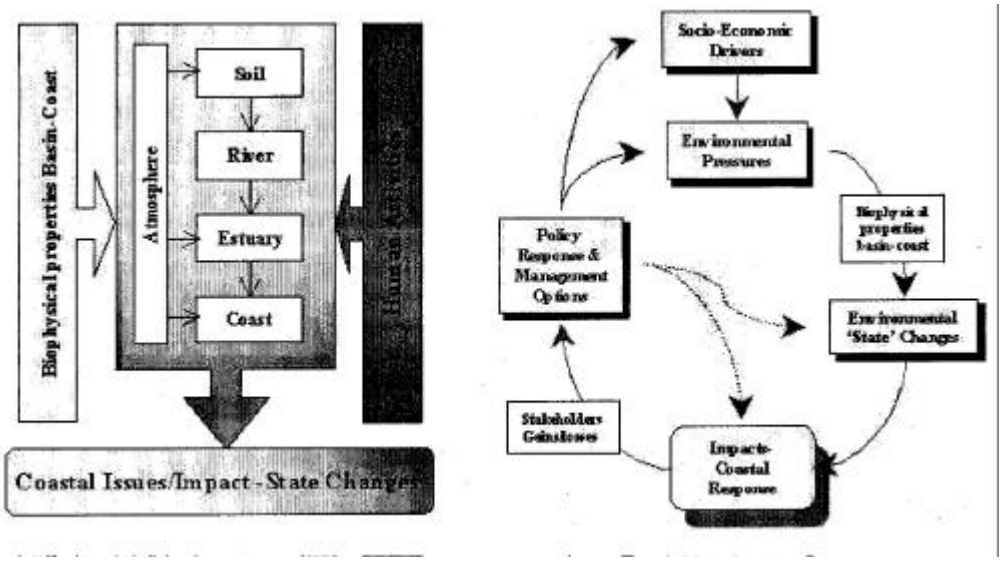
have no real place in the model, so that it cannot lead to satisfactory improvements in environment.

The first step made by United Nations Commission was to modify the model completing 'pressure' with '*driving forces*'. This comprises human and natural actors having a role in coastal areas and gives reference about social conditions surrounding the 'pressure' itself.

Human motivation, in responding to the state of environmental conditions is another element missing from the P-S-R model. Society will respond only to those environmental issues that have a social impact. Balancing priorities is very important to any management. Indicators that measure the *impacts* to human and ecosystem makes the model more useful for managers (Bowen, 2003).

In conclusion, the Driver-Pressure-State-Impact-Response Model is a more comprehensive approach that not only focuses on appropriate indicators and data acquisition systems but, also gives conceptual models in building socio-economic indicators

The D-P-S-I-R model:



(Fig. 5 D-P-S-I-R Model -Bowen, 2003).

This indicator framework is accepted by the European Commission to be of greatest value in understanding the dynamics of socio-environmental integration. (Bowen, 2003)

3.3.Forms of coastal management

Besides the models and the indicators used in managing coastal issues, there is actually historical experience the states have in managing and protecting the coastal areas. There is an obvious evolution in coastal management and the general trend is towards a systemic and integrated perspective.

3.3.1.From coastal protection to sustainable development of coasts and integrated coastal management

Starting from the Declaration of United Nations Conference on Human Environment (Stockholm, 1972) to the cornerstone Rio Declaration (1992) and Agenda 21 the general evolution of management is from merely to protect the environment to the adoption of the sustainable development concept.

The coastal areas, with an increased complexity and fragility compared to other areas, need special management schemes. In both developing and industrialised countries a progress from a developmental to a maturer concept of management can be seen. (Vallega, 1993-Table 1)

Historical Model of Coastal Management	
Stage 1	The preparation for take-off
Time:	Late 1960s
Objective:	Use development
Uses under management:	Single use or a few uses
Management area:	The nearshore or a narrow land-sea interface
Stage 2	Take off
Time:	1970
Objective:	Partial use management and environmental protection
Uses under management:	Multiple-uses
Management area:	Delimited through administrative or arbitrary criteria
Stage 3	Drive to maturity
Time:	1980's
Objective:	Comprehensive coastal use management, environmental protection and conservation of special and fragile areas
Uses under management:	Generally all uses
Management area:	Landward: delimited by various criteria; Seaward :coincident with the extent of national maritime jurisdictional zones
Stage 4	Maturity
Time:	1990's
Objective:	Integrated coastal zone management involving both uses and ecosystem All
Uses under management:	Landward: delimited by various criteria
Management area:	Seaward: coincident with national maritime jurisdictional zones, generally the exclusive economic zone

(Table 1: Historical Model of Coastal Management- Vallega, 1993)

In Agenda 21, Chapter 17(Area A) is an important 'moment' in integrated management development. Though the definition of 'integrated management' was not provided, it was indicated that the purpose of integration was to optimise the relationships between coastal uses in conjunction with the protection of the coastal ecosystem (Vallega, 1993).

On one hand there is an expansion and a contextual evolution of management goals and the spectrum of coastal uses to be managed.

On the other hand, the is an expansion in the perception of the extent of the coastal zone and its subsequent environmental implications (Idem.).

The present stage of coastal management is characterised by:

- Unanimous acceptance of sustainable development principle as a cornerstone within all national and international policies so that coastal management programs have to be consistent with this principle
- A non-mechanistic concept of the ecosystem, which is seen as a whole and not as a range of physical and biological features. It should be accepted that the same kind of human stimuli may not create the same response from the ecosystem.
- Multi-disciplinary approach based on the *isomorphism* with new disciplines having a big share among which ethics importance is expected to grow.(Vallega, 1993)

Scientist and managers need to have in mind both the concept of *ethical value* to evaluate coastal programs and to build up scientific *isomorphism*.

Ethical values refer to:

- *relationships between human behaviour and the ecosystem*: The more the integrity of the ecosystem is preserved the more coastal management is ethically consistent
- *social relationships*: The more social equity is guaranteed the higher the ethical standard of coastal management(Idem.)

The *isomorphism* consists of concepts and principles accepted by all physical, biological or social disciplines. An example of isomorphism is the concept of **structure**. It is defined as a set of elements closely linked to each other. 'Structure' can be used to describe coastal ecosystems, as well as coastal community, legal framework, etc.

To promote a more integrated approach of the coastal management, attention had to be moved from the conventional structuralist approach (v. Table 1 - the 'drive to maturity' phase) towards the **general system theory** based approach. This theory applied to coastal areas concentrates on the objectives towards which the whole system proceeds during its passage over time – as the chore of the assessment. The external environment has a more important place than in the structuralist approach. There is a special attention towards, for example, sea-level variations due to climate change and subsequent coastal erosion, or the inputs from the international political context, maritime transport in a larger scale, trans-boundary pollution etc.

In conclusion, the key element in the general system approach is **coastal system changes.** It is more important to know the changes, than to assess in detail the structure of the coastal system. Changes are investigated taking into account both *endogenous factors* (e.g. new exploitation of resources, the role of new groups of immigrants, etc) and

exogenous factors (e.g. ratification of new international convention, the policy of big transport companies, etc) (Vallega, 1993).

3.3.2.Integration and general systems theory-based approach

3.3.2.1.Integrating the objectives

The general system theory applied to coastal areas emphasises the need of integrating the objectives. This implies a strictly goal-orientated approach. The target towards which the coastal stakeholders' structure evolves is essential.

Integrated objective is based on a holistic approach, including the ecosystem as a whole (with both biotic and abiotic elements) as well as use-use and use–ecosystem relationships. The ethical and environmental needs consist of assuring the ecosystem integrity and enjoyment of the ecosystem for the future generations by minimising the man-made ecosystem changes. (Vallega, 1993)

3.3.2.2.Boundaries of ecosystems

Managing the coastal ecosystem as a whole, so that a single programme covers the whole extent of one ecosystem or a set of contiguous ecosystems takes an important place in coastal integration. Accomplishing this objective requires that all the ecosystem or contiguous ecosystems are under the same jurisdictional cover.

The delimitation of the ecosystem is a binding issue. Presently, however, only few abiotic components are taken into consideration. They are geological or geographical for example when delimiting the continental margin or continental shelf as the extent of the ecosystem. They could also consist of some proprieties of the water column, for instance when assuming the euphotic or neritic zones as the extent of

ecosystem. A holistic approach is yet to be reached until criteria based on contextual consideration of both biotic and abiotic components are assessed. The coastal areas delimitation is still based on arbitrary distances from coastlines or baselines, administrative boundaries or jurisdictional limits. (Sorensen and McCreary, 1990)

3.3.2.3.External environment

The coordination between coastal management and the external environment is crucial for a real integration. The **external environment** is the set of all elements outside the structure with which the structure is linked to. Like the coastal system, the external environment consists of the ecosystem and human communities.

Following again the general system theory, it can be seen that coastal system interacts with its external environment by receiving inputs and giving outputs and subsequently changing its internal state to react to the inputs.

Based on Adalberto Vallega, three components of the external environment have a special relevance to integrated coastal management:

- The *natural cycles* are essential for assuring the integrity of the ecosystem. That is why they have to be assessed by predicting their future evolution and possible impacts on the local scale. The International Geosphere-Biosphere Programme (IGBP) handles this by basing its analyses on climate change, hydrological and sedimentary cycles. Its Land-Ocean Interactions in the Coastal Zone (LOICZ) has a special relevance for the coastal management;
- *The legal framework* i.e. international and regional conventions as well as national jurisdictional belts is an important indicator for the progress of integration;

- *Restructuring many decision-making systems* including intergovernmental organisations, national and local authorities and also the financial, manufacturing and tertiary companies etc. is essential. They have to be in tune with the objectives established and Agenda 21's guidelines. This is the most important component of external environment.

3.3.2.4.Integration: a dynamic process. The relevancy principle

The management is integrated not only when all components are included in a single framework but also, and more important, when potential and expected factors are considered in practice.

The relevancy principle requires that the driving forces have to be considered according to the effect they have on the coastal area and external environment. This effect has to be consistent to the management objectives.

The relevancy principle-based approach can deepen the assessment of conflicts among coastal users and can provide solutions to prevent and mitigate them. This approach demands the assurance that driving forces – mainly the human driving forces – are congruent with the sustainable development objectives. The intrinsic reasons of conflict have to be considered. The conflicts to be mitigated are in relation with the constraints raised by the need of sustainable development such as: maintaining of coastal environment quality, efficient resource uses, maintaining future options etc.

3.3.2.5.The political process of integration

Viewed from the general system perspective, a special importance in integrated management is given to the decision-making process. 'The decision making centre' can be defined as an

‘organisation that uses information systems and operational mechanism to forecast the future’. (Vallega, 1993).

The framework of decision functions is complicated because the agencies are often endowed with multiple roles at different levels, -i.e. international, national, regional, local. In the integrated management, integration of agencies into a single co-ordinated system becomes very important.

To develop a comprehensive policy the actions have to be consistent both in vertical and horizontal dimensions.’ In the vertical dimension it means that specific actions should be taken by different agencies conforming to general guidelines. In the horizontal dimension, it means that only one policy is being pursued at any specific period of time in a full range of relevant sectors’. (Vallega, 1993)

4.ICZM-a complex international concept

4.1. ICZM: definition and characteristics

Integrated Coastal Zone Management (ICZM) is a broad concept used for the first time in USA in the ‘70s.

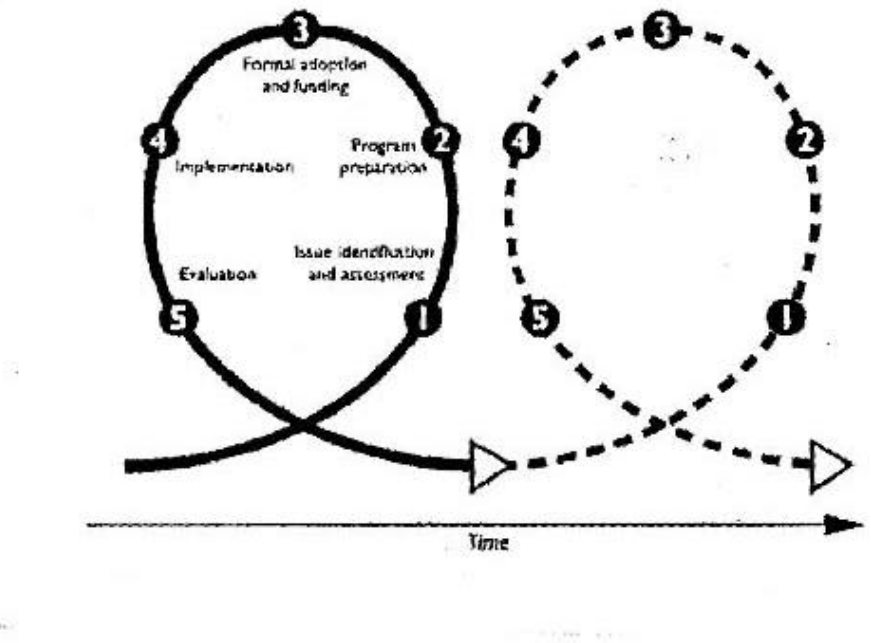
Nowadays is being accepted in many of the coastal countries as the right framework towards coastal protection and development.

Basically ICZM was seen as the management of the coastal zone taken as a whole in relation to local, regional and international goals with a particular focus on the interactions between various human activities and resource demands both within the coastal zone and between activities from the coastal zone and activities from other regions. A part of the management was the integration of environmental protection goals into economic and technical decision making process. (OECD, 1993)

Recent definitions (European Environmental Agency, 2003; PROCOAST, 2000) emphasise the fact that ICZM is a dynamic, continuous, iterative and multidisciplinary process to promote sustainable management of the coasts. As shown before, the ICZM is **based on the general system theory**. This process unites in one complex ‘general system’ government and community, science and planning, sectoral and public interests by promoting and implementing an integrated plan for the protection and development of coastal systems and resources.

An effective management involves an increasing number of disciplines – geomorphology, marine geology, oceanography, law, economics; geography etc. all together building up a multi-disciplinary, integrated view- a key point in development of ICZM.

ICZM covers the full cycle of information collection, design of planning, decision making, management and implementation, but it does not stop here as it is dynamic (because the system involved are usually extremely dynamic) and iterative. This means a continuous need of review and adaptation to the new conditions so that the cycle has to be started once again (Fig. 6).



(Fig. 6 The steps of the coastal management cycles-Richter 2001)

ICZM is also based on the awareness i.e. not only the use of both traditional and scientific knowledge but also the informed participation and co-operation of all stakeholders to asses the societal goals in a given coastal area and take actions towards meeting those objectives. The key points are on the one hand the dialogue and co-operation among stakeholders and on the other hand the co-ordination and integration.

4.2. ICZM dimensions

The integration covers different dimensions:

- Horizontal integration –i.e. integrated planning related to socio-economic and ecological aspects,
- Vertical integration at various administrative bodies , at different levels of communication International co-operation- National government- Regional/County level- Local/Municipal level;
- Territorial integration taking into account the interrelations between the land and the sea, the terrestrial, estuarine, littoral and offshore components of the coastal zone;
- Integration through time in a consistent manner of the policies, planning and management strategies;

Another essential aspect of the integration is *community participation.*

Community participation

The participation of the public is essential in assuring the sustainability of ICZM. Jentoft (Simionetti, 2001) identifies two different types of communities:

- The 'ideal' community characterised by a social group having shared beliefs, a stable membership, the expectation of continuing interaction and a pattern of direct and multiplex relations ;
- The 'less than ideal' community which is a society of people with more individualistic motivations, characterised by ' social fissures , inequities and power differentials'

The first type of community is more likely to be receptive of what we could call 'community-based co-management' of natural resources. In this case the individual members and the community as a whole have an incentive to cooperate and restrain individual behaviours for the benefit of the entire community. This could contribute to a sustainable

exploitation of resources and to a community's ability to sustain the process of ICZM. The ICZM can also be seen, in this case, as a set of *actions that build communities,* as they will act in accordance with the needs of sustainability. Doing this implies for the ICZM practitioners to have knowledge of the nature of specific communities and the larger forces of culture, markets and society. (Simionetti, 2001)

The Århus Convention (1998) concerning public right for information on environmental problems is fully embodied in its letter and spirit in the ICZM process. The integrated management includes by definition the participation of all the stakeholders ensures that no limit should be placed on the participation of the local community or general public. Calling for extensive public participation in decision making, the ICZM shows that negotiation and mediation before decisions are taken reduces conflicts and minimises the need for judicial proceedings. This will save energy, cost and, most important time which may be crucial given the risk of irreversible environmental damage. (Mecadie, 1999)

4.3.Benefits of ICZM

Over the long term, ICZM can assure the needed balance among environmental, economic, social, cultural and recreational objectives, all within the limits set by natural dynamics.

From the economic point of view, ICZM can reduce both conflicts between competing activities; risks to capital investment and can improve the efficiency of public and private investments.

Administratively, ICZM, by facilitating co-ordination of policies, plans and management strategies at all levels- local, regional, national- helps to achieve a consistent development of objectives and activities linking land and sea based management. Having the consistency induced by ICZM, the region/county can deliver effective responses to

international (for example EU) directives and obligations (Procoast, 2000).

Three major outcomes of an effective ICZM can be underlined (Richter, 2001):

- development of a robust and well-informed ICZM process;
- positive changes in societal behaviour towards economically rational, socially responsible and environmentally sustainable forms of development;
- improvements in the quality of ecosystems and social systems.

4.4.Constraining factors of ICZM

The ICZM is a long process, which takes a lot of time and commitment. Dealing with complex and dynamic factors it is better for the integrated management to be built upon a simpler but sound foundation. If it is over-ambitious it might risk failure and loss of self and public confidence.

The factors that can constrain ICZM (after Peter R. Burbridge) are:

- Separation of the terrestrial and marine components of the coastal zone from the legal and institutional point of view;
- Sectoral approaches of the economic development planning and management of coastal areas and natural resources;
- Lack of cohesion and consistency in policies, planning, investment and management strategies at different administrative levels;
- Lack of political awareness of the strategic importance of coastal areas and resources.(PROCOAST 2000)

4.5.ICZM Approaches

There is not only one single right ICZM approach.

While the sustainability is 'not a set of prescriptive actions' (Key & Alder 1999), ICZM is **a process that leads to action** (Simonetti, 2001).

Seen by many as **an environmental management strategy**, ICZM 'seeks to synthesise principle and realities, operationalising them into decisions about coastal resource use'. ICZM ***prescribes behaviour***, which affects a wide range of natural environments and human institutions. There is no Golden Rule or universal framework for promoting ICZM. The diversity of cases – corresponding to the variety of coastal systems and composing driving forces- makes reasonable the great diversity in approaches to the development and co-ordination of ICZM process.

4.6.ICZM at the Global level

Since its arising in the 70's ICZM proliferated many efforts had been made in this respect in many countries of the world. In the year 2002, there were approximately 700 ICZM efforts in existence around the world. (Hildebrand, 2002) Current inventories are further developed and reviewed by ICZM practitioners and international assistance agencies.

These ICZM efforts take place in all parts of the world, in all types of political regime, at all levels of governance at all levels of national economic development and in all types of environments. At the sub-national levels there are over three times as many ICZM efforts then at the national level.

There is an obvious similarity in the specific problems and development opportunities that have motivated the initiation and development of a great majority of ICZM programs. This similarity regarding the motivating issues occurs although there is a considerable variation among coastal countries in terms of socio-economic and

environmental conditions, morphological and climatic factors, laws and institutional systems.

Since 1990 there is a considerable increase in the number of developing nations and developing semi-sovereign states involved in the ICMZ process at the national or local level. Most of these developing countries have received substantial support .It is usually non-reimbursable grants from international assistance institutions (e.g. World Bank, GEF, Inter-American Development Bank, Canadian International Development Agency etc.) for the initiation and preparation of an ICZM effort. The support for implementation is provided as a loan not as a grant. (Hildebrand, 2002).

4.7.ICZM Progress in Europe

The European coastal areas confront with problems related to both dense populated and remote areas consisting of unplanned development, decline of traditional sectors coastal erosion and insufficient transport and communication networks. (European Environment Agency, 2003). Of course these problems differ from one region to another.

A European ICZM strategy was announced by the European Commission in 2000 and is now been implemented. The strategy consists of a package of tools and instruments that European Commission can use to promote ICZM. (Commission of the European Communities, 2000). A flexible approach is needed nevertheless, as there are great differences between the Member States in terms of administrative, legal and cultural context, as well as level of maturity in coastal management.

The first step is the recommendation from the European Parliament and Council to the member states. The recommendation includes the need for national monitoring and information diffusion.

The EU strategy needs to be implemented with the aid of complementary actions of European Environmental Agency (EEA). EEA delivers information about coastal areas by products like 'Corine erosion atlas' but also in more general problem of ICZM information.

As many of the problems of individual coastal zones are related to the driving forces within the same regional sea the EU will promote development of ICZM at the 'regional seas' level, including collaboration with neighbouring non-EU countries, with whom EU shares a common border. (Commission of the European Communities, 2000) In this respect the European Commission gives greater emphasis in meeting its obligations not only under large international conventions (i.e. United Nations Convention on the Law of the Sea), but also under regional seas conventions (i.e. HELCOM, the Barcelona Convention).

ICZM has been developed mainly at regional and local levels and through the European demonstration programme (European Environment Agency, 2003). The European implementation of ICZM has mainly two interrelated approaches:

- the availability of information- a prerequisite for developing the understanding of solutions to the problems raised by ICZM,
- the communication process within and between the administration, the sectors involved and the general public;

The European Union for Coastal Conservation (EUCC) identified a 'progress in ICZM in coastal regions per country' indicator. It is based on three criteria: horizontal integration, vertical integration and public participation. Fully established ICZM per region should be developed in all these directions (European Environment Agency, 2003).

Based on the information obtained from the experts from different EU regions (using questionnaire), four categories have been established for

the indicator: fully established, partially established, in progress and finally little progress or no ICZM.

One of the main problems encountered was the lack of information in some regions.

Progress in ICZM was assessed for 181 regions in 14 countries. The main conclusion was that in most countries, some progress has been made in ICZM, but ICZM has been fully established in only a few regions.

Progress towards establishing ICZM in coastal regions of EEA countries

	Length of coastline (km)	Coastal regions	Status of ICZM (no. of regions)			
			Fully established	Partially established	In progress	Little/No progress
Belgium	98	2	0	0	1	1
Denmark	4488	14	0	0	14	0
Finland	1 100	10	0	0	3	7
France	7205	11	0	2	3	6
Germany	1864	5	0	0	2	3
Greece	5333	12	0	1	5	6
Ireland	5148	14	0	0	2	12
Italy	7409	15	0	1	5	9
Netherlands	861	5	2	1	2	0
Norway	21 930	14	0	0	5	9
Portugal	924	7	0	0	5	2
Spain	6567	10	0	0	5	5
Sweden	3 220	14	0	0	3	11
UK	15911	49	1	0	11	37
Total		**182**	**3**	**5**	**66**	**108**

(Table 2 Progress towards ICZM in EEA countries - Elgurg-Velinova, 1999)

As shown in the table, ICZM is completely established in regions from the Netherlands (Wadden Sea) and the United Kingdom (Dorset) and locally also in France, Italy and Greece. Over half of the coastal regions have made little or no progress. Countries like Denmark, the Netherlands or United Kingdom have made most progress because of a longer tradition in coastal management strategies. In the other countries, since 1997, the EU Demonstration Programme, mentioned before had an

important role in stimulating the development of ICZM. In some countries, national studies or strategies have also stimulated progress. Regional exchange of experience has also contributed towards the development of ICZM. (Elgurg-Velinova, 1999)

5. ICZM in the Danish approach: a double assessment

5.1. ICZM as an "assessment test" of the Danish environmental approach regarding the state of the coastal environment

5.1.1. Introduction: purpose and *modus operandi* of the analysis:

In the first part of this work, we try to understand the main characteristics of the coastal system and of the ICZM concept. The purpose was to describe this framework in a way that expose its roots but also its efficiency and functionalism.

As we have already said, the ICZM concept is not an end in itself but a mean to an end, i.e. the sustainable use of the coastal areas and resources.

As a tool, the ICZM process gives guidelines, incentives and general ideas to succeed in a well-integrated management within national borders.

As a way to solve environmental problems ICZM is not a foolproof solution that has to be applied without flexibility. It is an iterative and holistic process. The second sub-section will assess the effectiveness of the ICZM as a solution to environmental problems.

But first and foremost, we will explain why the other important utility of the ICZM concept, to our view, is to make an assessment of the institutions and legislation regarding the state of the coastal environment.

Before being a remedy, ICZM is a diagnosis.

The purpose of this first sub-section is to use the ICZM framework as a background to analyse and assess the efficiency of the planning and the management of the Danish coastal areas.

Basically, we want to underline the main trends that are promoting a good management of the coastal areas in Denmark and on the other hand, the tendencies that may be impeding a good administration of the Danish coasts.

This analysis can not be exhaustive, but it will deal with very significant examples of Denmark: the eutrophication example will be our case study and other, less detailed, examples will complete the trends the case study has put into light.

To sum up, the first part of the project has given us the knowledge that we are using now to assess the management and planning of the coastal areas and resources in Denmark.

ICZM will be used as a filter to draw an effective map of the Danish successes and failures in the coastal management. Indeed thanks to the first part of the project, we have acquired knowledge on ICZM. So the analysis of the Danish coastal management will not be objective, but "ICZM oriented".

In other words, we will have a European viewpoint on Denmark bearing in mind that Danish institutions have their own features.

But before constructing the assessment of the Danish coastal management and planning, there is the need to explain why Denmark has been chosen insisting on the physical and institutional aspects (the latter have been selected and analysed in the perspective of the ICZM's principles mentioned above).

5.1.2. Why Denmark?

In our project of making a double assessment of the ICZM concept in itself and of a country via the ICZM, Denmark has appeared to represent relevant characteristics to achieve this assessment.

First, the Danish coastal areas, through their importance and the activities they create are a significant example of the strong interactions (mentioned in the first part) that ICZM has to integrate.

Then the state of coastal management within Denmark gives ground to the "double assessment". Indeed if Denmark is not considered well advanced in the implementation of ICZM, it is at least in progress. Moreover the Danish long and elaborated experience in the management of coastal areas can sustain a comparison with the ICZM model.

Finally, if we consider the definition of the ICZM given by Roger G. Bennet (Future Perspectives on Integrated Coastal Zone Management, 2001), "Planning" has to be included in the concept:

"I include planning because the two go hand in hand and because planning is a very significant instrument of integration, for shaping priorities and drawing up the frameworks within which sectoral management is to operate."

As it will be illustrated below [§ 5.1.2.2], "Planning" is the main action taken by the Danish government to administrate the coastal areas.

5.1.2.1. The Danish coasts: a valuable and fragile resource.

Four seas surround Denmark: the Baltic Sea, the Kattegat, the Skagerak and the North Sea. Along with Greece it has the longest stretch of coast in Europe (7300 km) in relation to the size of its territory.

The coasts of Denmark are, with their variety and diversity considered unique in Europe.

These varied and dynamic surroundings create the framework for a multitude of biological habitats and ecological systems. For example the birdlife along the Danish coasts has international importance (Ramsar Convention 1971; EU Bird Directive 1981.)

These fragile ecosystems represent an extremely valuable resource for the whole country. This means cultural and natural values but also economic, recreational or rural values. Indeed, the sea and all the activities linked to it (i.e. fishery, wind energy, tourism, offshore oil plants) generate many benefits. Then the landside of the coastal areas has also considerable importance regarding urban developments, rural developments (agriculture), harbors and leisure activities.

All these activities are connected to the "driving forces" mentioned in the first chapter. They represent those "human driving forces" that nevertheless necessaries for the socio-economic life of the country need to be tightly controlled because of the substantial pressure they create.

But the Danish coasts are also under the pressure of some "natural driving forces".

The coastline is constantly changed by the wind, waves and littoral processes, including sedimentation and erosion. The relatively flat landscapes provide wide views, but they are generally vulnerable to visual effects of buildings and technical installations. Furthermore, many low-lying areas need to be protected against high tides.

As a maritime nation Denmark has a long tradition for exploiting the sea. Growing industrialisation from the late 19th century onwards further increased the demands for development sites in the coastal cities. In this process, former natural areas, dunes and meadows have disappeared, as has the original coastal profile in many areas.

The Danish coasts are therefore faced with a multitude of threats:

Pollution from land, land reclamation, land development, fishing, exploitations of raw materials, coast protection and infrastructures, inshore shooting, disturbance from recreationists, afforestation, re-growth and cultivation, oil pollution and pressure from industry, urban development and related infrastructure, and technical installations.

So the many interests and the large current potential for change in the near-shore areas make it critically important to advance the possibilities for holistic, integrated planning and management of the coastal zone.

5.1.2.2. Danish coastal management structure

Coastal management has a long tradition in Denmark. Indeed, since 1874, Denmark has had a “Dike Protection Law” and a “Coast Protection Law” defining the owner’s responsibility for the physical coastal activities and their consequences.

As early as 1917, the “Nature Conservation Act” (the current “Protection of Nature Act”) formalised the right of public access to all Danish beaches.

But the coastal management as we know it now dates back to the 70s when Denmark was experiencing its political institutional re-organisation.

The management of the coastal areas in Denmark is regulated according to a three-fold scheme: first the planning system, then the Nature Protection Act and finally, the sectoral regulations.

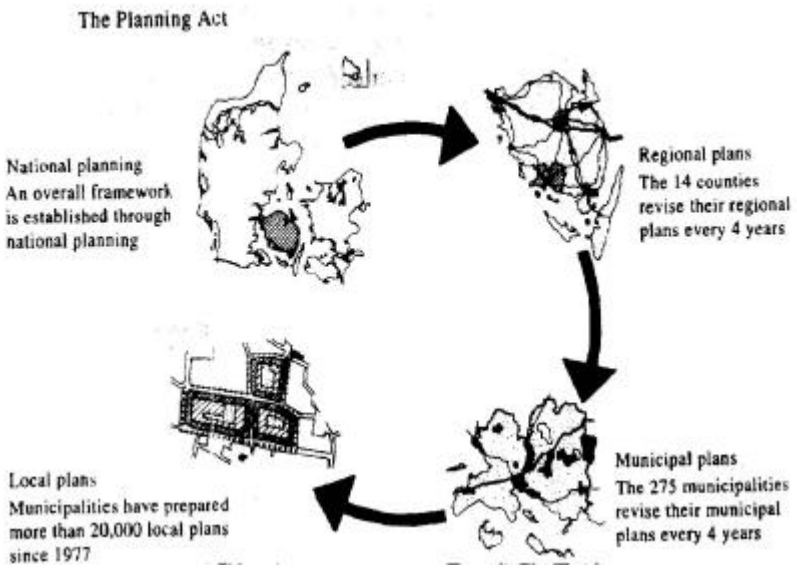
The central piece of the structure is the planning process represented by the **Planning Act**.

The planning system in Denmark is a ***land-use planning system***. Indeed there is no spatial planning for the marine area.

The key legislative basis, the Planning Act, divides the responsibility for spatial planning between national, regional and local levels. This structure dates back to 1970, when a highly decentralised system of administration, which gave considerable power to the local authorities (i.e. 14 counties and 275 municipalities), was established.

The Ministry of Environment is responsible for the planning system. It elaborates an overall framework setting the general guidelines for spatial planning. Within these general guidelines, the regional authorities are responsible for countryside planning. Each county must have a regional plan covering the total county area and establishing the overall objectives for development for a 12-year period (with a revision of the plan every four years). Then on the basis of the regional plan, the municipal authorities draft municipal plans. The local project must comply with the restriction set by the municipal and regional plans.

The figure [7] is an illustration of the Planning Act functioning.



(FIG 7 Worm K. 1997)

In 1994, the Planning Act not only became the basic rule for spatial planning, but also the key element for coastal spatial planning. The Danish Parliament ran a revision of the previous Planning Act (1992) stipulating that the new Planning Act should contain guidelines for coastal management. It adopted measures ensuring that special planning

and function justifications would be required for permitting building projects and the designation of new areas for development in the coastal zone.

More precisely, the 1994 Planning Act updated two regulations from 1981 and 1991 that ensured the protection of the remaining open, unspoiled areas, summer cottage areas and urban areas and *the public access to the coast.*

It designated a *coastal zone extending approximately 3 km inland*, which as far as possible should be protected from new development projects.

In 1991, the regulation was changed in order that it should encompass ***all*** economic activities within the coastal zone and not only recreational facilities.

To sum up, the Planning Act sets a **spatial restriction** for new developments.

Locations near the coast require a "planning related" or "functional" justifications. This restriction varies according the zones concerned; three zones have been established:

- *Urban zones*: constructions are tightly monitored (permit required).
- *Recreational zones*: prohibition of designating new summer cottage areas; no possibility to convert them into urban zones.
- *Rural zones*: projects that are not necessary for agriculture need a special permit.

The Planning Act is also promoting Environmental Impact Assessment for development projects of major change (mandatory for vacation centers and hotels with floor space above 50 000 m2). (Miljømimisteriet, 2002)

The other fold of the regulation-structure of the Danish coastal management is the **Nature Protection Act** (the Protection of Nature Act since 1992).

Since 1937, *a 100-m protection zone* along the entire Danish coast has been stipulated in the Nature Protection Act. In this zone, it is prohibited to alter the state of the beaches and other stretches of the coast. All natural coastal habitats are protected, including the Wadden Sea and dunes.

In 1994, the protection zone in rural areas was expended to 300 m from the start of continuous land vegetation.

In summer cottage areas, the protection zone remains at 100 m as a maximum.

On the urban waterfront the protection zone may be 100 m or less. . Here the Protection of Nature Act sets a **spatial prohibition** for new activities.

It also ensures *the public access to the beaches*.

Considering the two systems of regulation that have been presented so far, management in Denmark appears as a national concern to ensure that open coasts ***will remain*** an important natural and landscape resource.

Finally, the third part of the regulation-structure is a set of many **sectoral laws** (the list below is not exhaustive) generally related to the State and most of them concern sea-based activities.

The Environment Protection Act (1974) aims at preventing and controlling pollution of air, water, land in order that social development will be on a sustainable basis.

On the marine side of the mean water level, it imposes the county councils to elaborate and implement water quality plans.

With *the Raw Material Act* extraction from the seabed is only permitted in designated areas where permits can be given (by the State).

The Harbour Act and *the Fishery Act* regulate sea-based activities, giving the State the main authority.

The Coast Protection Act (1988) promotes co-ordination of coastal protection with other coastal activities and the integration of environmental issues in a coastal erosion management process.

The co-ordination of those sectoral laws linked to the coastal areas is supposed to be ensured by the Planning Act.

So basically we can say that the Danish coastal zones are thus regulated by no less than 26 acts and a number of different systems of regulation.

Having described the regulation-structure of the Danish coastal management, a brief overview of the authority-structure of the coastal management may give us another perspective.

As it may have transpired from the preceding part, the three State levels are in charge of the coastal areas. But each level has its specific tasks.

The State:

If the State level has only a general role concerning planning in the landside of coastal zones, its role concerning **sea-based sectoral activities** is of major importance.

Concerning the marine areas, the law states in general terms that any activities along the West Coast of Denmark and activities within 300 m of the coast in the rest of Danish waters will need a license from the central government.

Many of the sea-based sectoral laws (for example the Raw Material Act, the Fishery Act, and the Harbour Act) give competence to the State.

On the other hand, certain landside sectors that could have impact on coastal areas are also legislated by the State: the Agriculture Act, for example.

The Counties:

Counties are the **key level** concerning **spatial planning** for the **land-side** of coastal areas. Indeed coastal management is a task that transgresses the municipal borders. That is why each county is the main manager of the coastal area even if paradoxically the management/planning is limited to the landside.

- it administers and monitor the overall environmental conditions on the county land-side area.
- it is in charge of giving permits to the large industries and supervising them.
- it administers of the inland raw materials extractions.
- it has competence for agricultural planning.

The Environmental Protection Act gives also a thin, but not inconsiderable, responsibility to the counties concerning the seaside. All bays and fjords and other coastal areas out to a depth of 6m or at least within 1Nm from the shore are considered to be part of the counties regarding environmental protection. In other words, the county councils bear the responsibility for the quality of surface and groundwater.

The Municipalities:

According to the "Framework control" principle, municipalities must cooperate with the counties on the spatial planning. When considering the urban planning and the wastewater treatment, they respect

the environmental guidelines set within the regional plans. Municipalities also have responsibilities concerning the landside planning since they deliver permits and supervise small companies and big farms.

But the municipalities are also closely related to the State level. Indeed the main municipal organisation; the LGDK (Local Government Denmark) is extremely powerful at the national level as far as it concerns environmental matters. In comparison, the association of county councils in Denmark does not have the same political clout.

That is why, for example, a municipality and State cooperates on the Harbour sector.

Obviously, coastal management in Denmark is a long lasting process, deeply elaborated and consists mainly in land side planning and national sectoral legislation.

But it seems that this management is not efficient enough to provide a good protection of the coastal systems.

Indeed the following examples will show some failures in the coastal protection and try to explain why.

5.1.3. Danish environmental issues: description and analysis in a "ICZM perspective"

5.1.3.1.Case study: eutrophication:

Most coastal areas of Europe show signs of eutrophication. Due to specific natural dispositions, Denmark's coastal areas are confronting eutrophication at a wider magnitude magnitude than many other countries.

The main coastal parts touched by eutrophication are the Baltic sea, more precisely the Danish coasts of the Kattegat (for example the

Limfjord; a sound in the northern part of Denmark connecting the Kattegat and the North sea) (S. Sverdrup-Jensen, P. Blanner 1996).

The situation in Denmark:

As stated by The State of the Environment in Denmark 2001, the majority of the Danish fjords, coastal waters and inner marine waters do not meet the environmental quality objectives set for each type by the counties.

Most of the areas, related to the Baltic sea present the symptoms of eutrophication e.g. phytoplankton blooms and oxygen deficit. That is mainly because since wind direction in Denmark is mainly west and north-west, the eutrophication contribution is less in the Danish North Sea area than for the waters east of Jutland.

Indeed according to a report from the EEA , increased phytoplankton production followed by decreased oxygen concentrations in the deep waters are no longer restricted to deep basins of the Baltic sea, but reaches also the Danish coastal areas (EEA 1995).

Also, since the early 80s, oxygen depletion has become a common phenomenon along the coastal areas. The average annual oxygen concentration during autumn in the bottom water of the Kattegat has declined from 4mg/l to 3mg/l during the last 30 years (Richardson 1996).

Those conditions may reach such a level that the bottom fauna may not survive causing a decrease in the fish stocks.

That is what happened in 1986 when dead lobsters were presented on Danish television as a result of eutrophication problems.

The Limfjord case is also relevant to illustrate the problem of eutrophication Denmark is facing (ibid.). The fjord has been experiencing a 25-year decline in its economically important fish stock. It has resulted

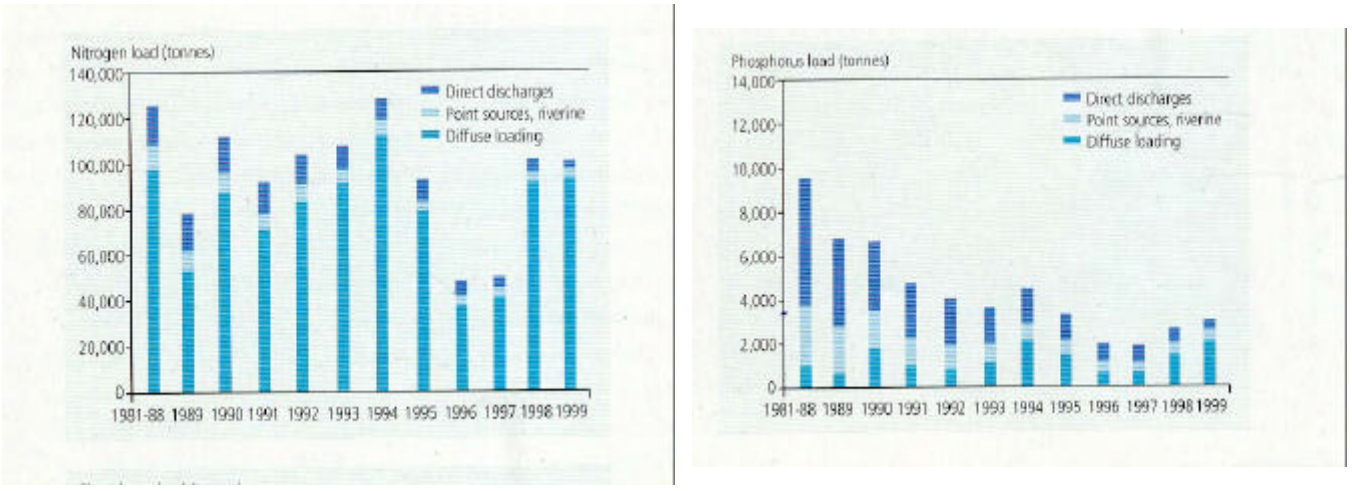
in a total reduction of 96% in the official landings, leaving the Limfjord fisheries in a severe crisis.

If the causes of this decline were still not clear in 1996, it seems that eutrophication has been playing a major role. Indeed, vast areas of the Limfjord seabed have been suffering from oxygen deficiency due to the very high growth rates of plankton in the fjord. In both 1994 and 1995, the deepest parts of the fjord covering some 25-30% of the total bottom area were hit by oxygen deficiencies.

The causes:

The main cause of eutrophication is an excessive nutrient loading (Nitrogen and Phosphorus) transported by the watercourses to the lakes and the coastal waters. Nitrogen inputs to marine waters correlated with the amount of precipitation and riverine run off has averaged 100 000 tons during the 90s (FIG 8).

The Phosphorus inputs, which have decreased markedly over the past 10 years, were reaching 3500 tons in 1999 (FIG8).



(FIG 8 Nitrogen and Phosphorus inputs in Danish marine waters- Miljøministeriet 2001)

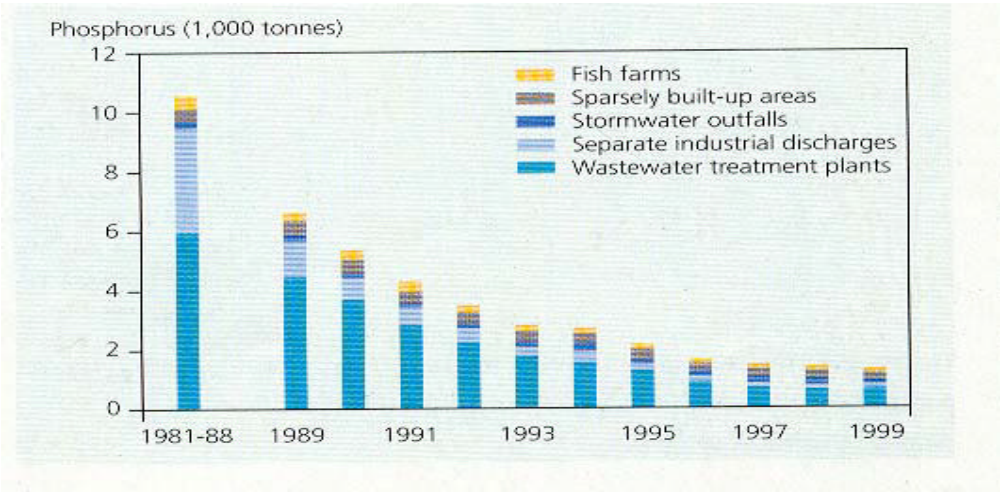
Many societal activities result in nutrients being discharged to the aquatic environment, e.g. through wastewater from households and

industry and loss of nutrients from agriculture and fish farming. In some areas, atmospheric depositions can also play a role.

The main sources of nutrients discharging can be divided into two groups:

- *the point sources*: wastewater treatment plants (wwtp), separate industrial discharges, freshwater fish farms, stormwater outfalls, sparsely built-up areas and marine fish farms.
- *the diffuse sources*: cultivated land, uncultivated countryside and atmospheric deposition.

If the wastewater treatment plants (wwtp) and the other point sources were big polluters in the 70s and the early 80s (FIG9), they have made considerable improvement since then.



(FIG 9 The share of different sectors in Phosphorus input- Miljøministeriet, 2001)

Phosphorus and nitrogen removal was mainly incorporated into the wwtp after adoption of the Action Plan for the Aquatic Environment in 1987.

Nevertheless the ***agriculture*** remains the most important source of nutrient loading.

An assessment made in the mid-eighties (Npo report 1985) evaluated the nitrogen discharge from the agricultural sector to be 260 000 tons per year. This discharge may be realised either by leaching or by atmospheric deposition.

This number is all the more significant compared with the wwtp discharges which at the same time were only about 20000 tons.

The nutrients are mainly contained in manure and commercial fertilisers that the Danish agricultural sector uses to meet crop requirement for nitrogen and phosphorus.

When the nutrients are applied in greater amounts than can be taken up by the plants, part of the surplus leaches down to the grounwater or run off into watercourses, lakes and finally coastal areas. A study run by EUROSTAT in 1997 shows that Denmark ranks 4th in the biggest surplus within the EU countries.

That is why agriculture in Denmark accounts for 4/5 of the nitrogen load in nitrogen loading's trend and riverine run off to the sea.

Regarding the phosphorus load, half derives from agriculture while the remainder derives from point sources.

The consequences:

Unsurprisingly, the consequences of the eutrophication are complex and involve many sectors. That is why as a sectoral-encompassing problem, eutrophication is a relevant issue to be assessed by the ICZM framework.

First, as demonstrated in the first part, the eutrophication has an impact in the proper environmental field.

Meanwhile the eutrophication has also a socio-economic aspect. Indeed if we go back to the Limfjord example, we have a rather good

illustration of the potential negative effects that eutrophication might have.

In the Limfjord, fishery has been a resourceful activity for decades, forming the economic base for several small towns along the coast of the fjord. The most economically important fish species are the eel, the plaice and the flounder. When the fish stock has been declining, it is the whole region which has suffered.

In 1993, only 21 tons of eels were caught compared to the approximately 800 tons/year in the middle of the century (ibid).

The consequence is also rather simple: no more fish; no more fishery.

The decline in job opportunities has had detrimental effects on the many local settlements and villages along the coast. As the alternative job opportunities were few, not only the young generation has left for the larger urban areas, but also people in their productive ages have departed, leaving behind only the old and the retired. This has turned many of the coastal settlements into “ghost settlements” for most of the year. And this poses some problems to the local authorities.

Tourism has also been affected. Indeed the “charm” and the atmosphere of the small traditional fish landing places could not be sustained under these circumstances. This development will impact negatively on tourism as many tourists have been particularly attracted by the fishing community ambiance.

Still dealing with eutrophication and tourism, the Køge Bay in the south of Copenhagen may be a good example.

Køge bay is a rather shallow open bay, which is highly eutrophic receiving waste nutrient loading. Eutrophication, here, manifests itself with mass occurrence of filamentous algae. Consequently fishing is

reduced due to fouling problems. But tourism in that area is also undermined by that state of things.

Indeed when the algae are washed ashore, they cause a nuisance and create hygiene problems for bathing and swimming besides aesthetic problems and an unpleasant odour.

The way we have described the Danish eutrophication has given ground to state that this issue constitutes a “ICZM case study”.

Indeed, eutrophication implicates:

- several sectors: agriculture, fishery, environment, wastewater treatment plants;
- several actors : the State, the counties, the municipalities, the citizens;
- many areas: the sea coast, the fjords coast, the rural areas, the urban areas;
- several elements :the land and the water.

This abundance of interests and actors and the need to integrate them puts directly the eutrophication problem in the realm of the ICZM.

On the other hand, the “ICZM perspective” seems to be the most appropriate to analyse the eutrophication problem since it is a problem where “the external environment” described in the first part of the project (natural and human induced phenomena) plays a role.

Some kinds of “natural and historical” factors are involved and should be taken into account according an ICZM perspective.

Eutrophication is a product of a huge economic growth that has been affecting agriculture for the last 30 years entailing more varied production and more performing fertilisers’ uses and leading to more nutrient discharges.

Less structural, the weather is also a key factor in the eutrophication issue.

Indeed under favourable weather conditions characterised by high temperatures and little wind, decomposition of the phytoplankton will lower the oxygen concentration. Loading from cultivated land depends also on the precipitation; the amount of leaching increasing with the amount of precipitation.

If "historical" developments or natural events like the weather represent unavoidable processes, they are nevertheless or must be manageable.

If eutrophication is sometimes very problematical in Denmark, it conveys some failures in the management of this issue i.e. the integration of the many factors mentioned above. Eutrophication represents an ICZM case study because it needs to be integrated and because a lack of integration is at the root of the Danish problems.

5.1.3.2. Sea-level rise and Denmark:

Because of the low flat relief of Denmark, anthropologically induced climate changes and the subsequent sea level rise could constitute a major problem in the future. The estimations for the next 100 years do not seem to raise concern. The rise of 2-3°C in temperature with related changes in precipitation and in connection to a rather modest sea level rise of 50 cm can be handled. Nevertheless, Denmark is very ambitious in its attempt in reducing emission of greenhouse gases, notably CO2 (Fengler, 2000). The costs of mitigation are being discussed, especially after the Kyoto protocol (1998).

Due to the land movements a differential level of the sea level rise occurs throughout Denmark. In the southern part of Denmark, there is a continuous rise of about 1 mm/year, while in the northern part there is a nearly constant sea level. If the trends continue in the next 100 years, sea

level is estimated to rise by 10 cm in the Wadden Sea and to fall slightly in the North Jutland (Idem).

Sea level rise and its impact on the Danish environment

Sea level rise can create some important damage by enhancing some already existing littoral processes. It could exacerbate the erosion problems along Danish coasts, could increase the risk of floods despite the coastal defences. These will diminish the surface of the near shore ecosystems, which provide important habitats – especially as many breading grounds for birds.

Sea level rise could also enhance the problems of groundwater salinisation. Nowadays only a few Danish coastal areas have a problem with the intrusion of seawater intrusion into aquifer (e.g. Køge Bugt on Zeeland) but locally this problem may become more important.

Finally but not al least sea level rise could create problems with the infrastructure. Infrastructure should be built and developed taking into account the future sea level rise. When planning the dike system in southern Jutland, Denmark took into account a possible natural sea level rise of 30 cm for the next 200 years. Nowadays, for the future planning a 50-cm sea-rise is included (Idem.). Almost likely sea level rise of 52 cm was taken into account when building the Copenhagen Metro and the new town district 'Ørestad' on Amager.

On the contrary the Danish sewage system and wastewater plants have been planned without taking into account sea level rise (Idem.)

The Danish management of the issue

a) *Coastal defence*

In Denmark, the main legislation regulating coastal defence measures is the Coast Protection Act of 1988. It states a procedure that the relevant authorities, local, regional or national have to follow when a

private or public initiative for building or altering coastal defence constructions comes up. The authorities responsible for legislation are the Danish Coastal Authority (DCA) under the Ministry of Transport and the counties. The principle is that the responsibility for establishing and maintaining protection measure lies with the ones who profit. (Common Wadden Sea Secretariat, 2001)

In this particular problem the counties having as a framework make the Coast Protection Act the co-ordination the Coast Protection Act. The Coastal Act demands that any construction should not have undesirable effects or conflict with nature protection rules.

The local municipalities and other relevant authorities are always asked to comment on the projects. The approval of all such projects has to be obtained from the DCA.

The general policy of the country concerning coastal protection is to interfere as little as possible accepting the natural processes. These conflicts in some cases with the local people interests who want to protect their proprieties (Norcoast, 2001).

The public participation and its obligation to undertake coastal defence is, generally, not compulsory. In particularly extreme conditions, for example at the Wadden Sea is considered public duty to enforce and erect dikes. The financial support is mainly from public funds through the issue of special construction laws. (Common Wadden Sea Secretariat, 2001)

b) Nature Protection

In Denmark, the main authority in nature protection is the National Forest and nature Agency under the Ministry of Environment and Energy. Its responsibility is to assure the protection of International Nature Conservation Areas (Ramsar, EU Bird Directive and EU Habitats). The administration is, again, at the county level. County gives

permits, carry out maintenance tasks, plan and monitor and disseminate information. (Idem.)

The regulatory measures include a ban in changing the natural conditions in salt and saltwater marches, not only in the 300 meter general protection zone as shown before. There are also dune conservation regulations.

In the Wadden Sea zone there are made even steps forward due to the regional co-operation. In 1997, at the 8th Trilateral Governmental Wadden Sea Conference (Stade, Germany) was decided that after investigating the sea level rise impact an integrated coastal defence and nature protection policies should be stated. The most significant improvement is done by the Executive Order on Nature Conservation and Wildlife Reserve in Wadden Sea It ensures a sustainable development of this national and international nature conservation area. The Executive Order regulate in detail: land and sea traffic, the collection of organisms from the sea bed, hunting, coastal defence, alteration of the terrain, canals, mineral extraction and other technical installations. (Idem.) In Denmark, the Executive Order falls into the jurisdiction of the Ministry of Environment and Energy and the National Forest and Nature Agency. It involves other authorities such as The Ministry of Transport and the counties (Idem.).

This inter-sectoral approach and decision-making all in a single legal frame that can be seen concerning the Wadden Sea is, probable, the right approach concerning the sea level rise issue.

5.1.3.3. Marine pollution:

As shown before, there are various substances that can affect and harm the coastal environment constantly flowing into the sea coming from human activities.

The sea is primarily contaminated with heavy metals some of them very persistent in the environment (e.g. cadmium and mercury accumulations).

The Danish goal in coastal pollution is to reduce the concentration of heavy metals to values close to background level, i.e. the natural occurrence. With the exception of cadmium, concentrations of heavy metals are dropping in Danish waters. In many places the background level is almost accomplished, but there are also places as Øresund and some inner fjords with high levels of heavy metals that affect organisms. (Miljøstyrelsen, 2001)

PAHs are substances occurring from oil: oil spills from shipping, oil extraction and spillage from industrial processes at sea. In Denmark the general PAH level is low. Levels harmful to fish and small animals have only been found in fjords with slow water exchange and near point sources of contamination.

The pollution affecting Danish coasts does not solely come from Denmark, but also from other countries. Although Denmark improved a lot in reducing sea pollution, the Baltic Sea, for example, receives contaminated river water and atmospheric fallout from Eastern Europe. For an effective policy towards the sea international co-operation is strongly needed (Idem.).

Most of the actions taken against marine pollution (heavy metals and hazardous substances) by the Danish government have consisted in banning the most harmful substances.

It is true for the group of polychlorinated hydrogenated aromatic hydrocarbons i.e. the PCBs' chemicals and the DDT and HCH, which were used as insecticides.

Antifouling agents, i.e. tributil tin (TBT) are also very toxic substances that are applied to ship hulls in paint to prevent fouling by marine organisms.

Its use on ships of less than 25metres has been banned.

Lowering the harmful substances from point sources has made another step in the marine pollution management.

Indeed wastewater treatment plants and industrial plants are now regulated. The introduction of cleaner technology in industrial production processes and limitation of the use of the most harmful substances have reduced inputs of many of the substances.

Finally the monitoring of hazardous substances in Danish waters has been a considerable help in the reducing of the marine pollution.

Indeed a nation-wide co-ordinated monitoring of hazardous substances and heavy metals in the marine environment was initiated in 1998 with the Danish Aquatic Environment Monitoring and Assessment Program, NOVA-2003.

Monitoring improves the knowledge of substances' concentrations in Danish marine waters, thereby better enabling the assessment of their environmental effects. Consequently, determining which substances need to be regulated is easier.

All these measures taken by Denmark convey a elaborate national management of the marine pollution. However, as it has already been said marine pollution is not only caused by national sources. International sources are playing a major polluting role. Consequently an ICZM approach at a regional level could help Denmark to cope with its marine pollution problems.

5.1.4. Danish coastal management: analysis of the problems in a "ICZM perspective"

As shown before, Denmark has a long tradition for vertically integrated management of the landward part of the coastal zone. It includes significant decentralisation and management integration between authorities at national, regional and local levels. But if this management is really elaborated, the critic we can make is that it is rather "static". Indeed the main part of the coastal management consists in land-use planning and the protection of the coastal zones can be defined as a will to keep landscapes in their most natural state.

But when more "dynamic" problems occur (when it does not concern planning i.e. eutrophication via nitrogen pollution), the vertical co-ordination is not as efficient as it uses to be. Indeed most parts of the sector legislation, which regulate the coastal zone, do not have similar provisions for decentralisation of the management competence.

Agriculture and the eutrophication issue

As mentioned above , coast is supposed to be administrating at the county level via the Planning Act. On the other hand agriculture remains in the State realm. It has its own ministry; the Ministry of Agriculture and its own legislation the Agricultural Act.

So to speak, eutrophication problems are experienced at the county level while the cause of the problems lies within the State's occupations.

Basically to overcome the nutrient loading from the cultivated land and consequently the eutrophication, counties are without any resource unless the State decides to tackle the problems.

Here the lack of vertical integration is worrisome.

What is obvious here is the fact that counties, which are the main managers of the coastal zone, do not have a dynamic action on the coastal protection. Indeed, planning is a good way to keep a landscape in a

natural state. But when a dynamic problem like eutrophication appears, counties may lack resource (concerning agriculture, counties and municipalities have just a planning competence).

However, if the lack of vertical integration is obvious when it concerns sectoral regulations, the objective sets and implemented via the Planning Act are met most of time. For example, concerning the water quality objectives and the wastewater treatment plants, the counties set the former via the Planning Act and the municipalities are in charge of the latter. So when the first Action Plan for the Aquatic Environment were launched, the objectives set for the wwtp were reached far more rapidly than for the agricultural discharges (that are actually still not met). This underlines the fact that the decentralisation within the planning process is well-achieved and well integrated (the implementation tools i.e. subvention, knowledge are well provided).

Nevertheless if the vertical lack of integration is only partial in Denmark, the lack of integration between land and sea areas is blatant.

The reason for the poor sea-land integration is most probably the management barrier, which is put in the shoreline in the Danish regulative system.

The management of resources and activities in the *near-shore sea territory* is undertaken by a number of sector authorities (mainly the State) on the basis of narrowly delimited sector legislation. The management of the *in-land territory*, as we have seen it, is primarily the responsibility of the regional and local levels.

This state of things does not fit with the “general system theory” mentioned in the first part neither with the ICZM principle; indeed the Danish coastal ecosystem is not handled as a whole entity but cut into two systems and managed in two different ways.

Consequently such organisation may lead to rather problematical situations. The high-speed ferries (sea-based activity regulated by the Ministry of the Transport) sailing near the coast (in-land territory), for example, pose a serious threat for the aquatic birds. Indeed when the birds moult they do not have the possibility to fly away from the shipping lane. On the other hand, during the wintertime the foraging period is so short that all daylight hours are of vital importance to their survival.

Sectoral integration is also incomplete in Denmark.

This lack of integration is not something characteristic of Denmark. Indeed as we explained it at the beginning; one of the main purposes of the ICZM framework is to integrate competing activities and balance interests of the different stakeholders in the coastal areas. Since coastal areas are economic valuable resources, many interests are at stake and the probability for none integrated competition (with its negative side effects) is high and Denmark does not escape the rule.

Still dealing with the eutrophication problem, we can easily say that in Denmark the agricultural sector is a very powerful one. *Mogens Moe* in its book *Environmental Administration in Denmark (1995)* states that the agricultural organisations play an extremely decisive role and negotiate with the Ministry of Agriculture and "virtually ignore the Ministry of the Environment". With this interest-oriented configuration, regulations are delicate to elaborate and above all difficult to implement.

Indeed, many actions have been led by the State in order to change the agricultural practices for a decrease in nutrient discharges:

-The Action Plan for Sustainable Agriculture (1981)

-The Npo Action Plan (1985)

-The Action Plan for the Aquatic Environment (1987)

Recently a second Action Plan for the Aquatic Environment trying to link the concerned shareholders has been launched (1998) but the mid-term evaluation is not available yet.

In each of the previous plans, the targets set by the government were not met. This may be due to a lack of implementation at the sub-levels of the State. For example, the municipalities are in charge of supervising the farms. But farmers hold many influential positions in municipal councils and they may try, at the local levels, to circumvent the State orders.

Concerning the Limfjord case, at least 3 sectors may be involved: agriculture, fishery, and environment. If on that case, a good integration of the 3 sectors has been made [Sverdrup- Jensen, S., Blanner, P. 1996], this practice is absolutely not generalised. Indeed there is no generalised authorities encompassing the sectoral regulations and the coastal planning.

This raises another problem in the Danish management: the top-down approach of the regulation that may hinder a good management.
With a bottom-up approach, compromises may be reached more easily. And this may be confirmed by the attitude of the Danish government towards eutrophication in the early 80s.

The Danish public had been aware of the eutrophication problem since 1981 and the environmental organisations have continuously pinpointed the problem since 1984 when eutrophication started occurring on a regular basis.

But it is just in 1986 with the dead lobsters' episode; when the eutrophication problem became "visible" that this issue came onto the political agenda.

Concerning the communication within the scientific knowledge area, more integration would be also needed. Indeed some cases show

that a scientific decision taken in one field may negatively affect another field.

For example, to cope with the eutrophication problem, it has been decided to use a " green field" strategy (Sibbesen et al. 1994, Hasholt et al. 1997). Experiments run recently, show that this strategy introduced by the government in 1987 has some unwanted side effects on the soil erosion.

5.2. Encouraging the ICZM Process in Denmark

As shown before Denmark has a very long experience and tradition in managing the coastal areas. Nevertheless this habitus in managing its coasts may be an obstacle in implementing the ICZM. (Chap. 5.1.2.2.)

An opportunity for a faster development of ICZM process could be Danish membership in EU and the regional co-operation. The need of having an integrated approach at the international level could 'transfer' the approach to the national level.

5.2.1.The EU policy influence in implementing ICZM in Denmark

The implementation of ICZM at the EU level (chap. 4.7) shows different approaches of the different states and different stages of implementing. Denmark is an EU Member State since 1972. The ICZM process is in progress in many regions (14) but has not yet been implemented. The EU strategy in implementing ICZM could play in future a more important role for Denmark as the EU institutions stress on the common vision concerning policy and development.

EU could play a major role by:

- Promoting ICZM activity within the Member States and at regional Level ;
- Making the EU policies compatible with ICZM;

- Promoting dialog between European coastal stakeholders,
- Generating and diffusing information on the best ICZM practice and knowledge about coastal zone. This will raise public awareness.(Procoast, 2000);
- Allocating funds for developing ICZM.

The EU Recommendation (Commission of the European Communities, 2000) stresses the importance of having coherent action at European level in ICZM and states some principles for a good coastal zone management. These principle summarise ICZM concept by the holistic long-term perspective, adapting management to local specificity, a natural processes based participatory management (Commission of the European Communities, 2000)

The EU Recommendation is a good reference point, as the Demonstration Programme was a good instrument (see chapter 4.7.), but for a real faster implementation in states like Denmark, there is the need of a more explicit strategy. This could follow two different approaches:

- The developments of further policy instruments that explicitly ***require*** or encourage the Member States to establish ICZM. These could be even ***legal instruments*** requiring ICZM establishment.
- Ensuring that all EU policies with direct or indirect effects on coastal areas take into account the principles of ICZM (Institute for European Environmental Policy, 1999).

The measures targeted at advancing ICZM could be:

- The Water Directive (Directive 2000/60/EC) as the most important legal stimulus for integrated planning; both for inland and coastal integrated planning. It produces detailed guidance of how the coastal management policy can be integrated in river management plans.

- An ICZM Observatory should be established to act for collection and dissemination of good practice and advice in relation with ICZM;
- INTERREG III[2] becoming the principal source of EU finance supporting cross-border, cross-national and inter-regional co-operation on ICZM;

5.2.2.Regional-coast management programmes a step forward in Danish ICZM implementation

If the ICZM framework has not been fully implemented yet, at least one of its main objectives; shaping new behaviour, is being achieved within the Northern region. Three regional processes have particularly attracted our attention: the Wadden Sea Plan, the Norcoast project and the Procoast project.

The Wadden Sea Plan is a regional agreement linking the coastal countries of the Wadden Sea i.e. Denmark, Germany and the Netherlands. This Plan is the product of a process that has begun 20 years ago and has resulted in the protection and conservation of the entire Wadden sea with nature reserves and national parks and the establishment and extension of the trilateral Wadden Sea co-operation between the three countries mentioned above. Its guiding principle is "to achieve as far as possible, a natural and sustainable ecosystem in which natural processes proceed in an undisturbed way" (Norcoast, 2001). This action has to be lead on the basis of existing national legislation but in parallel, it is entrenched in a wide network of international conventions and directives (Ramsar Convention, EU-Bird Directive). Accordingly, the financial support comes from the European commission.

[2] **Interreg III** is a Community initiative, which aims to stimulate interregional cooperation in the EU between 2000-06. It is financed under the European Regional Development Fund (ERDF)

The two other projects represent, to our view, one of the best means to path the way towards an ICZM implementation at the national level:

Norcoast (Norway, Sweden, Denmark, Germany, The Netherlands, England and Scotland) is a pro-active "hands-on" project for interregional co-operation on practical solutions for coastal zone management in the North Sea region. It consists in a four phases project run in one region of each of the countries mentioned above (Norcoast, 2001). The partners assess one another the good and bad practices regarding North Sea ICZM&P. By the way there is a real trans-national exchange of experience within the field of ICZM. Nevertheless, the best part of the project consists in the fact that this comprehensive assessment may either lead to a direct implementation in the region or may form the basis for a pilot project, recommended by the Norcoast partners and carried forth by the region in question. This could for instance consist of a temporal cancelling of parts of the national legislation i.e. those parts that may constitute the constraints in the planning process (e.g. the concept of "test-counties" or "free-counties" in Denmark). The advantage of this project is its iterative practical approach.

The ***Procoast*** project as the Norcoast one aims at translating environmental concerns into practical management solutions for the coastal zones in the Baltic Sea Region through an exchange of experience between stakeholders and experts from different countries/regions.

Those attempts to implement an integrated trans-national coastal management have seemed to us the most promising way to achieve ICZM principles within national borders and so within Danish national borders. Both the frame and the substance of the regional agreements/projects are providing good incentives for further individual ICZM implementation.

Concerning the frame of those agreements, its pragmatic and functional approach is a real advantage, especially when it is applied on a medium geographical scale. Indeed instead of general directive coming from a superior level (i.e. the EU), those countries associations are based on a voluntary participation. The countries are sharing their own experiences and they can give each other feedback.

On the other hand, this regional approach may entail some "spill-over" effects. For example, in the case of the "free-counties" in Denmark; this pilot project designed on a common will basis could be enlarged to the whole country via a "spill-over" effect if it obtains good results at the regional level.

Another contribution of this approach is the fact that since the association is based on a common will; the communication is at its best level: "In order to optimise the communication between the partners the most modern ways of communication will be used whenever possible. Written communication will be based on e-mail and the project will establish its own homepage on the Internet to ensure a fast and cheap way of communicating information to other organisations and authorities interested in coastal zone management"(Norcoast, 2001).

Concerning the substance of those agreements, the exchange of different knowledge and experiences is a source of benefits for further integration. Moreover, the fact of learning from another country may have an incentive action on the other countries.

Finally, those projects give a strategic vision to the coastal management and consequently an added value to the ICZM process making it even more attractive for each country.

6. DISCUSSION AND CONCLUSION

The purpose of our work was to assess whether the world-wide known and agreed upon concept of ICZM is accomplishing its attempt in tackling environmental issues.

An exhaustive knowledge would allow us to give a straight answer. But this is impossible regarding the complexity we have faced going deeper and deeper in the theory.

As a theoretical concept, it is a globally shared view that ICZM can improve the understanding of the environmental issues. Indeed the systemic approach it provides is a considerable knowledge resource to understand the dynamic of the coastal areas and their way of reacting.

At the beginning of the project's research we could not have imagined how complex the working of the coastal areas were. However, we have understood how important it was to take this complexity into account to assess the management of the coastal zones. But the ICZM goes further overcoming the complexity of the detailed structure and considers the coastal area a single system acting like a living organism.

Consequently the ICZM concept as background knowledge is undoubtedly a good framework to assess and understand the environmental issues and the Danish approach has confirmed it.

Indeed in our attempt to analyse the Danish management of the coastal areas, the literature on ICZM has been a great help to put into light the trends impeding and expediting an integrated coastal management.

Denmark has a long lasting and elaborate management of the coastal areas, putting the counties at the front stage. This management is made in a structural way and on one hand this is a positive aspect. Indeed our "ICZM knowledge" made us realise that a long term view was needed

in the coastal management and the Danish structural approach is designed on the long run.

Nevertheless, we have also learned that managing the coasts was implying a dynamic multi-factorial management because of the intricacy of the coastal zones. Counties have a big autonomy and a wide range of capacities due to the high level of decentralisation in Denmark, they, however, are hardly able to cope with dynamic problems which go beyond their planning abilities.

Leading the analysis on Denmark has also allowed us to approve the efficiency of both side of the ICZM framework:

-*the ICZM as an end* i.e. the managing and the functioning of a coast in a sustainable way.

-*the ICZM as a tool* i.e. a mean to assess the obstacles that prevent from reaching the ICZM as an end.

On the other hand, the Danish approach has also permitted us to recognise the limits of the ICZM framework i.e. the ICZM as a tool to reach an implemented integrated coastal zone management.

Indeed no one of our readings has given us a clear view of how to solve environmental problems in ICZM way. ICZM remains a flexible frame, a way of behaving, a 'philosophy' but it is not with idealism that one can change a regulation structure or an administrative organisation or solve sectoral interests' competition.

Nevertheless it is true that ICZM may be a launching pad for initiating common actions like the Wadden Sea Plan but it remains something at the discretion of the individual State.

Finally this lack of concrete solution can be assimilated to the lack of dynamism the European Union is experiencing in many areas. Indeed it is worth recalling that the ICZM framework is concept which appeared in the 70's in the USA, by definition a dynamic society.

Obviously the European Union takes action in the coastal management but it is something rather conservative and static since it consists mainly in directives for nature conservation. This sort of dynamism is a common weakness of the EU when it deals with implementing political or management change within countries.

Coming back to the Danish case, the structuralism is deep implemented in the managing and planning system. This makes the progress of ICZM to be slow, as the 26 acts that concern the coastal areas don't assure a systemic view on the issues. They also make difficult the major legal and administrative changes. For example to accomplish the ecosystem-based delimitation of the coastal systems stated by ICZM by changing the rather geometrical delimitation (e.g. the 300 metres protection zone) the administrative costs would be high.

Indeed it is easier to go on with a very well structured system which functions well even though the problems exist.

A relation between the state of some environmental issues in Denmark and the level of integration of the sectors involved and of the decision making process was established when analysing three of the main environmental issues: eutrophication, coastal pollution and sea level rise.

Nevertheless the implementation of ICZM in Denmark will be accomplished sooner or later. The EU pressures and the voluntary regional co-operation could speed up the process.

ICZM is the right approach in tackling the environmental issues as it takes into account the real 'nature' of the coastal system.

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