Coastal Management in the Netherlands

Henk Jan Verhagen¹ and Krystian W. Pilarzcyk²

The coast is a very important aspect of life in the Netherlands. 60% of the Netherlands is below the sea level, everyone lives less than 200 km from a beach, and for most people the sea is less than 50 km away. But in the Netherlands there is officially no Agency for Coastal Zone Management, neither are there laws on Coastal Zone Management. On a first impression this sounds very strange. Of course it is not so strange, knowing the situation in the Netherlands. Because nearly everything in the Netherlands is related to the sea, an Agency for Coastal Zone Management should be involved in nearly all major decisions in the Netherlands. Of course, we have such an agency. It is the council of ministers. And indeed, in fact all matters regarding Coastal Zone Management are decided on a cabinet level.

Introduction

Ever since coastal areas are inhabited, people have had a long, but often uneasy relationship with the coast. Initially, the coast provided food and security. Later coast became foci for industrial and commercial development, and in recent years emphasis has shifted towards leisure and conservation, although all former uses remain important. Through these shifts of emphasis, man's perception of the coast has changed from one of respect to one of depreciation. It is best to view the coast as a common resource, available to all. However, we need to apply certain standards of resource allocation and use to the coast, in order to sustain its attractiveness. This aim can only be achieved through enlightened management. Such enlightenment comes only trough an understanding of coastal systems, enabling management to balance pressure ant to minimize risks. There is no doubt that this management will be a complex and difficult task, which requires knowledge over a wide range, but

Is coastal zone management worth while ??
What is the knowledge needed by a good coastal manager ??
What does it cost ??

To answer such questions, there are currently a number of issues facing coastal managers. Most require some degree of scientific knowledge before they can be tackled effectively. Almost all issues raise conflict between various coastal user and interest groups, between developers and ecologists, engineers and geologists and landowners and economists. Some issues can be smoothed by better education, others require legislation. In some cases conflicts can me anticipated and planned for, in others they are unseen and require restorative or remedial action. In recent years there has been a marked shift in coastal management from direct resolution of conflicts to towards planned (process-oriented) avoidance of them.

The term "coastal zone" is usually used in connection with coastal development projects. The dimensions of the coastal zone, both parallel an perpendicular to the coastline, are determined

¹ Associate professor in coastal engineering, Int. Inst. for Hydraulic and Environmental Engineering, Delft, The Netherlands
² Head research department; hydraulic engineering division; ministry of public works, Delft, The Netherlands
site-specifically per project. The outer limits of the coastal zone, however, are sometimes set inland by the watershed and/or the climatic boundaries, and seaward by the maritime boundary of the exclusive economic zone with a maximum of 200 nautical miles. In other countries, the limits of the coastal zone are nearer to the shoreline. There is no unity in the definition of the extend of the coastal zone.

Coastal projects provide increasingly attractive markets for coastal zone management expertise. A good project manager is instrumental in ensuring that the project will be carried out to the satisfaction of the international funding agency, which bases its approval for funding to a considerable extent on who the project manager will be.

In developing nations the coastal areas are often densely populated, fertile and the centre of economic activities and infrastructural development; but they are vulnerable to the effects of climatic change, in particular sealevel rise.

These areas are currently experiencing difficulties as a result of rapid population growth, not integrated coastal zone management and conflicting resource utilization. The problems frequently identified in the coastal zone relate to population safety (from flood-defence to contaminated drinking water), food supplies (from crop selection to harvest failure) and socio-well-being.

**What is coastal zone management?**

The terms coastal zone management, coastal resource management, integrated resources management and coastal area planning and management are often used interchangeably in the international literature. There are two components to this definition -- planning and management.

The first component, integrated planning, is a process designed to interrelate and jointly guide the activities of two or more sectors in planning and development. The goal of integrated planning is the preparation of a comprehensive plan which specifies the means to effectively balance environmental protection, public use and economic development to achieve the optimum benefit for all concerned. The integration of activities usually involves coordination between data gathering and analysis, planning and implementation.

This final point is the essence of the management side of the definition. Coastal management is the process of implementing a plan designed to resolve conflicts among a variety of coastal users, to determine the most appropriate use of coastal resources, and to allocate uses and resources among legitimate stakeholders. Management is the actual control exerted over people, activities and resources. Public participation plays a key role in both planning and management. [Hildebrand, 1989]

Sometimes the term "Coastal Zone Management" is used for what is in fact "Coastline Management". But "Coastline Management" is only a part of CZM; in fact it has to be the result of a good CZM-policy for one sector. Coastline Management is managing a coastline in such a way that the CZM-policy can be executed. Thus: maintaining the coastline at those points where it is necessary, but also a (controlled) retreat of the coastline in those places where maintaining the coastline position is not absolutely necessary.

The technical means to maintain a coastline vary considerably. Both soft measures (artificial beach nourishment) or hard measures (beach walls and revetments) can be considered. However, this is technical detailing of coastline management, and not coastal zone management.
The Netherlands
In the Netherlands we have a strong tradition in making zoning regulations, town and country planning and so on. The ministry of Environmental affairs, town and country planning and housing is one of the most important ministries in this country. In matters of planning the basis is the "memorandum on town and country planning", which is renewed every 10 years and in which the general policy of the government is described. This memorandum is prepared by the ministry, in cooperation with other ministries. Preliminary versions are discussed in detail with advisory boards, non-governmental organisations, lower authorities, etc. In this memorandum only the headlines are given. But even the headlines only make a thick book. At this moment the fourth memorandum is in preparation, and consists of many volumes.

In concordance with this "masterplan", sectorial plans are made by various ministries. For example the plan on Energy-distribution, on Recreation, on Natural Reserves, on Drinking water production, on Sea-defence, etc.

The provinces have the task to make spacial plans for the regions within their problems. In such a regional plan it is indicated where open areas are, where urbanisation is allowed, where natural reserves are indicated. These plans are the most important plans, also with regard to coastal zone management. Because in fact in the regional plan one can see whether in a coastal zone urbanisation is allowed, industry is allowed, etc.

On a local level the regional plans are worked out towards a local development plan. In such a local plan very detailed information is given. The local plans are made by the local (municipal) authorities. The local development plan has to be in agreement with the regional plan. Therefore the local plan needs authorization by the provincial authorities.

For all levels of plans extensive procedures exist to guarantee public participation. It is also possible to ask for appeal after a plan has been approved by some authority, if you think the approval is illegal.

In case of the coastal zone one may distinguish the "dry" coastal area and the "wet" coastal area. In the dry coastal area regulation is mainly done by the local authorities. Developments which have some effect on a somewhat bigger area have to be approved by higher authorities. Also for bigger developments an Environmental Impact Assessment is required. In the wet areas planning is generally done directly on regional level, and not on local level. Because the government has a big influence on all developments and infrastructure, the freedom of the individual investor in the Netherlands is quite limited.

Zoning regulations are extremely strict in the Netherlands.

The dune coast
At this moment all the dunes along the Dutch coastline fulfil the requirements of a safe coastal defence system. Along the coast of central Holland the dunes are able to withstand a one in 10,000 year storm. But at some places the dunes are just wide enough to fulfil the requirements. In 1990 42 km of the Dutch coast are so narrow that 10 m erosion will make them no longer fulfil the requirements. If no measures are taken against the chronic erosion, within a few decades many kilometres of the Dutch coast, especially in the south western part of the country are not safe enough. An increased sea-level rise will increase this problem.
The dune area consists of approx. 420 km². The Dutch dune area is one of the biggest coherent dune areas of Europe. It is a unique natural reserve of international value. A great part of it is subjected to the Law on Natural Reserves. Locally and regionally the dune ecological system has a variety of qualities. Dunes with small lakes, (freshwater)marshland, dry areas, shrub, moor and woodlands are varied with "normal" beachgrass or dry grasslands, strongly influenced by human activities. Besides its natural values, the dune area is also of economic value as a production area of drinking water and for recreation. It is used as urban area and at a few places as industrial area. Most of these functions are just behind the sea-dunes. Locally one finds in the sea- dunes a restaurant of some houses. Fortunately the sea-dunes are urbanized only on a few locations. The sea-dunes are a very specific element of the dune area. The most important function of the sea dunes is to act as a sand buffer for dune erosion during storm surges. By a landward movement of the coastline, the sea dunes move landward, and the user functions and natural values of the dune area are strongly affected.

Wetlands
In the North of the Netherlands is a wide intertidal area behind the barrier islands. This is a wetland of first order importance. This area has been designated as a natural reserve. Economic development in this area is very limited. With zoning regulations also the development of marinas at the adjacent islands is limited.

After damming several estuaries in the former decades a lot of intertidal area was lost. In the past the created lakes were mainly transformed into freshwater lakes. These lakes were important for watermanagement (irrigation of polders with freshwater during the summer period and for flushing the canals). At this moment it is clear that the ecological value of a saltwaterlake is much higher. Therefore the last big lake created (Lake Grevelingen) will stay salt. A special infrastructure (flushing works, sluices, etc) has been built to guarantee a good water-quality and a biological interaction for various species with the North Sea. A management-plan for this lake has been developed, indicating where recreation should start, where fishery can flourish, which areas should be protected as a natural reserve. Implementation of the plan was not only be done by regulation, but also with physical means. For example non-recreational shorelines were protected with broken rock to prevent access by the public.

Because of the damming of the estuaries, the intertidal area was decreased significantly. Mainly because of ecological reasons it was decided not to close the last estuary with a dam, but with a storm surge barrier, allowing a tidal flow in the estuary during normal conditions. Together with the construction of the barrier, also a detailed management plan for the estuary was developed. All functions have been charted and evaluated. On basis of this inventory a general, integrated management plan for the area was developed. In this plan is also indicated which authority is responsible for the execution of the various parts of the plan. So there is not one super-agency controlling everything. On basis of the plan (which is approved on various levels by various authorities, each authority approving only with consent of the people they represent) the various authorities work together, controlling each other.

Need for a coastal defence policy in the Netherlands
As has been already stated, care for the quality of the sea-defence as a means to protect the polders from flooding is the responsibility of the Waterboards. However it is the responsibility
of the national government to take care of the "foundation" of the sea defence. With other words, the national government is responsible for the battle against coastal erosion. Also at locations where the dunes are wide erosion can cause problems. At those points there is of course no danger for flooding of polders during storm surges. The problem here is that the relatively wide dune area often have a very high natural values and besides at various places accommodate a number of human activities or functions. The dunes are considered as a high natural system of high national value that needs to be preserved. It is the longest more or less uninterrupted dune coast of Europe and exhibits a large variety of biotic and abiotic gradients. Functions accommodated in the dune are: drinking water resources, recreation, living and such. At a few places people live in the dunes. Historically dunes primary functioned as sea-defence. Therefore, many dunes became the property of the Waterboard. Some dunes are owned by drinking water companies or natural reserve agencies. For the most part construction of houses in the dunes is not allowed. At present there is little private property and permanent housing in the dunes. Only temporary buildings were allowed, which must be removed before winter. Because of this policy, the dunes also became important natural reserves, although that was not the original intention. Dunes valued for ecological important functions, remained in a semi-natural state while the rest of the Netherlands became urbanized, or used for intensive agriculture. Beaches and dunes have very important recreational value not only for the 14 million inhabitants of The Netherlands but also for the densely populated Ruhr-area in Germany. For them, the Dutch coast is the nearest coastal recreation area. The beach width is generally not affected by coastal erosion. In principle coastal erosion only causes beach problems if a fixed structure such as a sea-wall lies behind the beach. In the dune areas there are recreational facilities such as camp grounds. Structures such as hotels and restaurants in the first dune-row are, of course, endangered by erosion. Originally, some villages were built just behind (landward) the dunes. As coastal erosion occurred these villages became closer to the sea (several times in history this required the removal of a village to a new location further inland). Today, in The Netherlands, demolishing houses because of coastal erosion is socially and politically unacceptable, although in some cases it would be economically acceptable. Therefore, the presence of villages near the sea requires a policy that maintains the coastline at its present location. In the Netherlands the dunes are also used for the production of drinking water. Because ground water in large parts of the Netherlands is brackish, it cannot be used for drinking water. In the 19th century the public water works of the big Dutch towns started to pump drinking water from the fresh-water lenses in the dunes. At this moment the natural supply from these lenses is not enough any more, and the lenses are supplied with river water (mainly from the Rhine river), which is infiltrated in the dunes and recovered later. Coastal erosion endangers the high investments in the drinking water pumping areas. Since coastal erosion can be a treat for all these functions and for nature preservation, there is a need for clarification and qualification of this problem in relation to coastal defence.

**Change in Dune Appraisal**

Today dunes play an important role in coastal zone management. First, better methods for determining safety of dunes were developed. In 1984 the "Technical Advisory Committee on Water-defences" presented guidelines for the evaluation of dune safety as a coastal defence (TAW, 1986). In these guidelines a method is presented to calculate the strength of a dune...
during a storm surge. This method is based upon a normalized coastal profile after a storm surge and an equilibrium of sand in this profile (Van de Graaff, 1986). Also, new techniques have been developed for coastal maintenance. Artificial beach nourishment has become important, partly a by-product of the dredging industry. Prices in the Netherlands are between US $ 1 - US $ 4 per cubic meter placed on the beach (Rijkswaterstaat, 1987). These low prices made it financially possible to switch from dune improvement at the landward side to improvement by beach nourishment.

A third important factor is the new regard of dune areas. Dune areas now have a much higher value because they are used as a source of drinking water, they have a very important recreational value and they are critical areas from an ecological point of view.

In the past years the nourishment projects were executed on an ad-hoc basis by the national government and not by the sea-defence authorities. This is caused by the fact that it are generally big projects and that sea-defence was very often not the main reason for the nourishment plan.

Since sea-level rise must be anticipated (now 20 cm/century, in future it will be more because of the greenhouse-effect) it is to be expected that the erosion problems along the coast will increase.

**Problems of the Dutch coast**

The dune coast is a flexible sea defence against the North Sea. Characteristic is the continuous movement of sand in the coastal zone. Currents and waves move the sand from and to the shore in cross-shore and longshore direction. This process may cause a loss of sand from the sea-defence zone to adjacent coastal sections or to neighbouring inlets.

Because of these processes there is a continuous movement of the borderline between land and water. Erosion and accretion alternate both in space and in time. Erosion nearly always causes problems.

There are two types of coastal erosion.

* A fast, sudden erosion of the dune front during storm surges, causing a considerable loss of sand to deeper water;
* A slowly, chronic erosion, which is not so striking, caused by sea level rise and morphological phenomena. Due to chronic erosion sand disappears from the coastal defence zone. An increase in sea level rise may cause an increasing chronic erosion. In that case also the coastal profile will adapt to the new waterlevel by moving in a landward direction.

In the Dutch situation the fast erosion during a storm surge is a problem for the Waterboard, the chronic erosion is a problem for the National Government. About half of the coast length is eroding. The coast in the Delta area is most severely attacked. The northern part of the Holland coast and Texel exhibit large erosive areas as well. In Texel, in addition is much faster than at other places.

According to our present knowledge the impact of sea level rise on the coast is twofold:

* First it causes a relatively deep underwater shore. In order to compensate that, there is a need of sand on the inshore zone. If this sand is not available from the sea bottom in a large enough quantity, this will cause a loss of sand from the dunes to beach and active zone. The sea-dunes, the row of dunes just adjacent to the beach, becomes narrower and moves in a landward direction: The direct effect of sea level rise. This effect will occur along the entire shoreline.
The second effect is an increase of some of the erosive processes; the indirect effect. There will be an increasing demand of sand from the coastal sections neighbouring tidal inlets. Because of the sea level rise the basins behind the tidal inlets will become deeper. This creates a need for sand to fill up the basins to a new equilibrium level. This sediment will partly be withdrawn from the coast. Especially if an increasing sea level rise is combined with a change in wind climate a significant increase of the erosion of the coastal sections neighbouring tidal inlets is expected.

An increase of sea level rise will result in an increase of erosive coast length. Besides the sections that are already eroding now will suffer an increased erosion.

For the areas near tidal inlets we expect an increase of erosion with approx. 0.5 m/year; for the other coastal sections this will be in the order of 0.2 m/year.

At this moment the dune coast along the entire Dutch coastline fulfil the requirements of a safe coastal defence system. Along the coast of Holland the dunes are able to withstand a one in 10,000 year storm.

However at some places there is hardly any spare width in the dunes where erosion can be awaited. The length of coast where safety can not longer be guaranteed is in the year 2000 about 20 km, rising to about 40 km in 2090. For the unfavourable scenario of sea level rise an increase of about a factor 2 with respect to the present-day sea level rise must be anticipated. These effects are most severe in the Delta area.

The dune area covers of approx. 420 km\(^2\). The effects of shoreline retreat on the dune area and functions accommodated here are also evaluated. In the year 2000 for the present-day value of sea level rise along about 40 km of coast very valuable nature area is lost. In 2090 this is increased to about 60 km. The effects that have been reckoned with are the loss of land due to the landward shift of the shoreline and the loss of area with a specific value (for instance wet dune valleys) that have been lost due to a landward shift of the back side of the front dune: since a minimum safety level must be maintained, a front dune with minimum dimensions must shift landward with the same pace as the shoreline retreat. Due to the landward shift of the (minimal) front dune a wet dune valley for instance sometimes has to be replaced by bare sand.

**Preparation of a coastline management study**

Although there are no massive developments in the dune area, the dunes are regarded in the Netherlands as very important. They are essential as sea-defence, they are important natural reserves, many people go there for a holiday, etc.

Erosion control along the (sandy) coast had had a low priority during the execution of the Deltaplan (closure of estuaries as a response on the storm surge disaster of 1953 - aiming the improvement of the safety of polders).

This decreased priority had lead to damage from dunes and from interests in dunes. This caused public discontent and made in 1987 the parliament order the government to develop a long term vision on erosion control.

The ministry of public works (responsible for coastline management) had the idea that coastline maintenance by artificial beach nourishment was feasible. However, this idea needed to be verified. Also politics should decide whether the investment in coastline maintenance is a sound investment.
To develop the long term vision the next three things were necessary:

a. Knowledge of:
   a1. the problem: an eroding sandy coast;
   a2. the threatened interests;
   a3. technical solutions for erosion control.

b. Alternative policies

c. A choice out of the alternatives

d. Interaction with public and politics.

In 1987 it was decided to base the policy-analysis on existing knowledge and measurements. Only a few black spots in knowledge could be solved with some research. Nearly 2 years were used to order the great amount of measurements and former reports of case-studies into predictions of coastal recession and accretion on three terms: 10, 30 an 100 years. The predictions, the knowledge of interests and technical solutions were integrated into 4 alternative policies in the same period. This resulted in a discussion-report. The government could chose an alternative after consultations and public participation.

**Alternatives for a coastline management**

Alternatives for a coastline management policy in any case must meet requirements concerning safety against inundation. Additionally demands concerning protection of other functions in the dunes can be made. Presented are four alternatives to parliament and public: Withdrawal, Selective erosion control, full erosion control, seaward expansion.

**alternative 1: withdrawal**

If nothing is done, the coastline will erode. This is not acceptable on locations where the dunes have only marginal safety. Everywhere where the dunes are wider, erosion can be allowed until the minimal dune width is reached.

This alternative is the minimal proposal. The coastline of the Netherlands will be determined by the natural erosion. Only at those locations where the safety of the polders is in danger, action will be taken. Generally the action will be beach nourishment, but also other solutions are possible (like the construction of a high sea-dike). After some years artificial headlands will be formed along the coast (the coast between the headlands continues to erode). The costs to defend these headlands will increase in due course.

If erosion continues, there is the possibility that villages in the dunes (not in the polder-area) have to be removed to a more inland location. This has happened often in the past centuries. Also damage will be caused to recreational areas, natural reserves and the drinking water production. The loss of land in the next decade will be in the order of 350 ha (800 acres) and 20 km of coastline has to be defended by beach nourishment or other means.

In a few cases also the dunes has to be improved on the landward side. This improvement will in value approx. 100 ha (220 acres). In this alternative all sea-dikes and groins will be maintained in the same way as it was done until today. A landward reconstruction of these structures has proven to be more expensive than maintenance on the present location. This alternative will cost 35 million guilders per year (18 million US $/year).

**alternative 2: selective erosion control**
The second alternative is control the erosion in a selective way. Here also safety is the primary aspect. But erosion is not only controlled in case of danger for inundation of polders, but also when important other functions are at stake. Because there are many functions in the dune area, some choices have to be made. What has to be protected, what is "important"? In this alternative the following choices have been made:
- all villages in the dune area will be protected;
- natural reserves with an (international) high value will be protected;
- infiltration plants for drinking water production will be protected;
- investments for recreation will be protected (hotels, etc.).

The expected loss of land in the next decade will be approx. 100 ha (220 acres), 60 km of coastline has to be protected and the cost are 45 million guilders per year (23 million US $/year). The details of this alternative have to be worked out on a regional level.

alternative 3: full erosion control
The coastline of 1990 will be maintained. Erosion will be compensated fully by beach nourishment. A small strip will be available for natural fluctuations of the beach. Nourishments will be performed on the beach, but probably also just in front of the beach, on the inshore zone. There will be no loss of land, 140 km of coastline has to be protected by nourishment. The costs are 60 million guilders per year (30 million US $/year).

alternative 4: seaward expansion
This alternative is a more active one than the other alternatives. In this alternative the dunes which have a marginal safety are improved by making more beach in front of them. This will be done by the construction of very long groins and other construction in the sea. This alternative has not yet been worked out in the same detail as the other ones, therefore the cost-indications are more tentative. The main purpose of this alternative is not the creation of extra land. Most of the constructed accretions are on locations were they do not have a high economic value. The purpose is improving the sea-defence. It is a more offensive policy than the other ones.
Also 140 km of coastline requires protection in this alternative. The costs are approx. 80 million guilders per year (40 million US $/year).

Method of analysis
To allow a good political discussion on the subject, and to inform decision makers on all aspects of the four alternatives a policy analysis approach was followed. For the four alternatives it was computed what would be the effects on coastal defence, on nature, on recreation, etc. and what would be the costs.
A computer model was made with a description of the coastal zone, with all the functions of the coastal zone and with the ability to compute coastal erosion as a function of time and sea-level rise. From a coastal engineering point of view the model is quite simple. It is more or less a curve fitting program using measured erosion rate data. But it is possible with this model to compute the coastline for example in 2020, if only beach nourishment is executed in front of villages and towns, assuming a sea-level rise of, for example, 60 cm/century. Knowing the coastline of 2020, the model counts how much land is lost with nature reserve, with recreational facilities, with individual houses, etc. Also the maintenance costs are calculated.
As a basis of the model an inventory of coastal knowledge regarding the Dutch coast was made, and published in 20 technical background reports, with a total size of approx. 4000 pages. These reports are available to the public. They are only available in Dutch. A list is referred to the appendix.

With this model a wide variety of alternatives was computed. Finally only the four alternatives mentioned before were presented. For the four alternatives three variations in sea-level rise have been computed. The present rate of sea-level rise (20 cm/century) is used in the costs mentioned above. Besides, two scenarios with increased sea-level rise have been studied. One with a sea-level rise of 60 cm/century and one with a sea-level rise of 85 cm/century plus an additional change in the wind-climate (mainly a change in the wind direction).

This resulted in the following data:

<table>
<thead>
<tr>
<th>Sea-level rise (cm/century)</th>
<th>Withdrawal</th>
<th>Selective Control</th>
<th>Full Control</th>
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<tr>
<td>85</td>
<td>155 %</td>
<td>160 %</td>
<td>165 %</td>
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Table: Extra costs for the alternatives 1/3 due to increased sea-level rise.

**Decision**
The information was discussed in various groups and in parliament. Based upon this discussion the Minister of Public Works decided in july 1990 that the alternative full erosion control was chosen by the government. This means that starting in 1990 all erosion along the Dutch coast will be compensated, mainly by applying artificial beach nourishment. The cost of the nourishment will be paid from the National Budget.

**Implementation**
After the decision was taken, it had to be implemented. "Preservation of the 1990-coastline" and "counteracting structural erosion" looks simple enough. For hard coastal structures, such as dykes, there is no discussion on the position of the coastline. But where is the 1990-coastline for a dune coast? And what is structural erosion. For these questions the concept of the basal coastline has been developed. The basal coastline is in fact the coastline-to-be-preserved. Every year a check is performed whether this basal coastline has not been exceeded.

The position of this basal coastline is determined for the whole Dutch coastline. The basal coastline is determined using a volumetric method. The advantage of this volumetric method is that small variation is the coastal profile does not have big effects on the position of the coastline.

With the same volumetric method every year the real (transient) coastline is calculated. The calculated coastlines are plotted in a diagram as a function of time. When the regression line through these observations crosses the basal coastline, the erosion is too much, and an artificial beach nourishment is planned.

**Conclusions**
Although The Netherlands don't have a special agency for Coastal Zone Management, CZM is in fact highly developed and fully integrated in the political and social system. There are no
powerfull coast-controlling agencies, but management is executed in a cooperative way, based upon management plans which have a firm basis in the groups of interest. The various partners work together by executing the plan. In recent years the influence of the environmental aspects in Coastal Zone Management is increased significantly. Because of history and strict zoning a good Coastal Zone Management in the Netherlands is feasible.

REFERENCES

Hildebrand, L.P., 1989; Canda's experience with coastal zone management, Oceans institute of Canada, Halifax, 108 pp,


Table:
Increase of several values in percent relative to the sealevel scenario of 20 cm/century. (for example: If the sealevel rises with 60 cm/century, the cost of erosion control in 2020 is 25 percent more than the erosion control costs in 2020 with a sealevel rise of 20 cm/century, if one chooses for selective erosion control.)

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<tr>
<th>year (sealevel rise)</th>
<th>increase in % of</th>
<th>amount of km to maintain</th>
<th>cost of erosion control</th>
<th>total cost of coastal maintenance</th>
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<tr>
<td>2020 (85cm + Wind)</td>
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<tr>
<td>T</td>
<td>85</td>
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<tr>
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<td>95</td>
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<td>30</td>
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</table>

T - Withdrawal  
S - Selective erosion control  
H - Full erosion control