Sea Ahoy!

Sustainable use of marine resources

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Sustainable use of marine resources

Climate change, sea-level rise, warming of the North Sea, extreme weather events, increasing precipitation in Northern Europe, droughts in Southern Europe, shifts in marine fisheries production, changes in tourism and recreational activities, destruction of marine habitats and an unsustainable use of marine resources – all are popular issues or concerns in the media and in governmental and scientific reports. The recently published study of the European Environment Agency, Impacts of Europe's changing climate, is an example of a study that focuses on the effects of climate change in Europe. Problems and risks dominate our view of the sea, while the measures to tackle these are mostly sectoral in nature instead of integrated or multi-functional. They also tend to focus on short-term solutions and seldom address long-term ones. Mostly these solutions are re-active rather than pro-active. In the Dutch foresight study Sea Ahoy! Sustainable use of marine resources *another approach was chosen.[1] This study offers an attractive bouquet of innovative concepts for future sustainable use of marine living resources in the North Sea. In the context of this study, which resulted in a 369-page publication in March 2004, a wide variety of Dutch experts and professionals participated in a two-year process, structured around so-called creative Design Groups.*

1 The foresight study was a co-operative project of the Netherlands Study Centre for Technology Trends (STT, The Hague, www.stt.nl) and the Innovation Network Rural Areas and Agricultural Systems (The Hague, www.agro.nl/innovatienetwerk). The Consultative Committee of Sector Councils for research and development (COS) facilitated the realisation of the study (The Hague, www.minocw.nl/cos).

The sea as friend and foe

The history of the Dutch is intertwined with the sea. Maritime transport and fishery constituted the basis for the wealth of the Netherlands in the fifteenth century, culminating in seafaring and exploration during the Golden Age. Scholars such as Grotius and Plancius have left their mark, the former by introducing the notion of *Mare Liberum* and the latter as a renowned mapmaker. The bond between the Dutch and the sea, however, has gradually changed over the centuries. Since the 1953 flooding of large parts of the Netherlands, safety and protection has been the number one priority.

The ensuing Delta works have become an icon of Dutch water policy and hydrological engineering. By closing off of estuaries, building impressive dykes and creating an advanced hydrological engineering structure for water management in our polders, the Netherlands evolved into a world leader in this field. Yet, there is a negative side to these interventions in nature as well, such as eutrophication, increased erosion and changed sedimentation patterns. A similar pattern of underestimating the complexity of nature and productivity of the sea is noticed in the ever-increasing exploitation of the North Sea, which is accompanied by such problems as over-fishing and pollution.

Global warming ..... again

Some ten thousand years ago natural global warming caused most of the landice sheets near the poles to melt, leading to a steady sea-level rise in the present North Sea, shifting the coastline eastwards at a ten kilometres per century

pace and finally drowning Doggerland. Sixty centuries ago the Dutch coast stabilised at its present location, forming an environment with large intertidal areas, estuaries, beach barriers and peat marshes. Due to this natural setting Dutch history is closely linked up with the sea and the struggle against it. Presently some seventy percent of the Dutch population lives, works and recreates below sea level. The polycentric Randstad is the economic powerhouse of the Netherlands. Schiphol airport and the ports of Rotterdam and Amsterdam form a crucial element in a global and European network. Increasingly, though, human activities have been contributing to climate change. These changes especially express themselves in densely populated, low laying coastal areas such as in the Netherlands, Belgium and Germany, as well as in Denmark, France and Italy. In Europe these countries are most vulnerable to sea-level rise. Similar situations occur in tropical countries such as Bangladesh and China. How do the Dutch cope with this new threat? The *Sea Ahoy!* foresight study provides several relevant answers.

The North Sea and the Dutch EEZ

The North Sea only covers 0.00158% of the world's ocean surface. Yet, situated in between seven heavily industrialised and urbanised countries, it is one of the most intensively used seas of the world. Apart from traditional activities such as transport and fisheries, today the North Sea shows a wide variety of human activity, including: oil and gas exploration, extraction of sand for construction and beach replenishment, gravel extraction, defence, recreation, offshore wind energy parks, aquaculture, telecommunication, deposition of slush and the discharge of pollutants.

The Dutch proclaimed their Exclusive Economic Zone (EEZ) in 2000. It roughly equals one and a half time the land surface. Through proclaiming an EEZ a country has the right, by international law, to exploit its marine resources in a sustainable way. Sustainability is a complex concept with a large number of definitions. Yet, there are some joint characteristics of this notion: it should address the needs of the present and next generations, involve the various different levels (from local to international) and pertain to at least three societal dimensions, namely economy, ecology and the socio-cultural. But the present institutional and policy arrangements are hardly capable of addressing the sustainable use of the resources within the North Sea, a highly dynamic marine environment.

In the period up to 2050 much extra fresh water has to be accomodated

possibly even 490.000 ha., almost 4 times the 'IJsselmeer'

Maybe, land should be given back to the sea or can be regained in other areas.

Back to the future: The Netherlands again a kingdom of islands?

The paradox of concurrent over- and under-exploitation

Despite alarming signals of stress and overexploitation of the marine environment due to human activity, the sea is under-exploited when compared to present land use. At land, hunter and gathering activities evolved into farming, industrialisation and a network society. At sea, however, fisheries still function in a hunter-gatherer mode while aquaculture is just in its infancy. As with extensive farming on land, pollution constitutes an immanent threat. After all, apart from these traditional uses of marine resources, there are many divergent marine living resources that promise new, unexpected applications, for instance in drugs and feed for fish and livestock. Despite the transition towards sustainable practises on land, sustainable resource use at sea is far less tangible. Here Grotius notion of *Mare Liberum* is still widely applied.

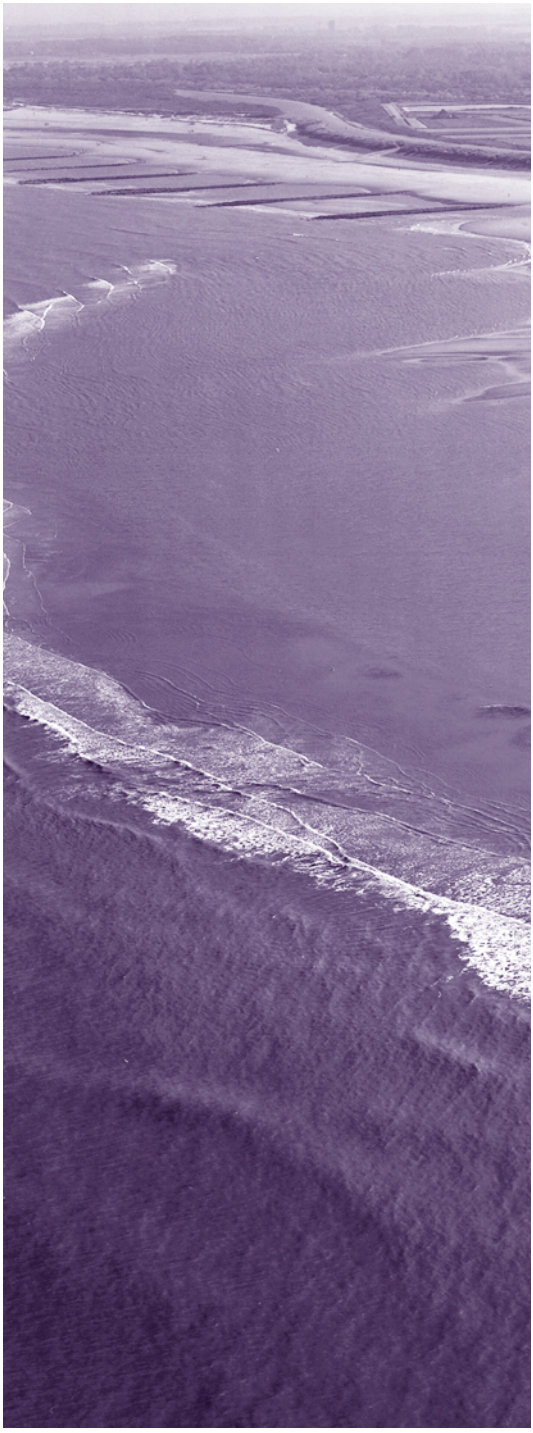
With a growing population pressure and lack of space on land, sea space is tempting. Our understanding of the sea currently finds itself at the brink of a series of breakthroughs. How can we use the sea for harvesting biomatter for food, for sustainable fishing and sustainable aquaculture activities? How can we use the vast and unique genetic and physiological properties of marine life? The sea is rich in resources and has a daunting diversity and productivity. The ocean promise may serve a multitude of human needs. But the ocean also is vulnerable to the detrimental effects of most human activities.

Paradigm shift: nature is the best engineer!

There is a need for a paradigm shift from a land-oriented mind to a sea-oriented one, for a transition from traditional, non-sustainable use of marine living resources towards sustainable and innovative use of these resources. This requires careful attention for the characteristics of the marine environment and the natural processes in the ecosystems. Their productivity and diversity is a source of inspiration for new (governance) concepts. Future use should be based on insights and understanding of the natural variability of the system and the effects of human activity upon it. This was the starting point of the Dutch foresight study.

As users, policymakers, consumers and citizens, we have to change our attitude towards the sea. Today, the sea or ocean as such is hardly part of our social

and spatial awareness. We tend to place ourselves outside the oceanic system and assume that we can manage it. But we can't! It is a challenge to allow the sea to enter our everyday awareness and to be inspired by the sea as a spatial reality. Our visions of nature, sustainability, consumer behaviour and economic profit should be adapted in tune with the complex processes that go on within the seas and oceans. We need a vision in which use, governance, protection and experience go hand in hand – a vision in which we consider ourselves part of the larger system of land and water that defines us.



Foresight study

Some seventy stakeholders from government, industry, science and NGOs participated in the Sea Ahoy! *foresight study. They participated voluntary in a series of meetings of structured but open Design Groups focusing on 'North Sea Riches', 'Sea Culture Parks' and 'Aqua Production Parks'. The challenge was to bring up new concepts or new experiments, ideas that involve true innovation[2] or anticipate specific key problems. A Steering Group, chaired by the Royal Governor of Zealand, guided and oversaw the study's overall process.*

1 Innovation requires change along more dimensions than R&D and technology development as such. Dimensions such as governance, market development, consumer's preferences, the development of a distribution network and market chain, also need attention.

Experiments and concepts

The main body of the *Sea Ahoy!* foresight study concerns a dozen concepts or experiments that could lead to breakthroughs in the management and sustainable and multi-resource use of the North Sea and the Dutch coast. All experiments sketch a specific situation, a vision to be realised around 2020. To meet this challenge a number of the proposed experiments need substantial R&D, while others merely require a restructuring of institutions or a change in the mindset of the Dutch policy makers, politicians and the public at large.

The eleven concepts or experiments address the various challenges of sea-level rise, sustainable fisheries and aquaculture, energy generation, governance, multifunctional spatial use and frontline applied research. As a consequence the experiments are rather different in nature. Some build on existing initiatives from a mostly innovative cottage industry, others involve visions of engineering companies or are based on new scientific insights. All, however, stress that the opportunities for a sustainable use of marine resources only arise with an understanding and acknowledging of the natural processes and productivity of the marine environment of the North Sea. The eleven concepts will be introduced in the remainder of this report. They are grouped under three headings, namely meeting challenges and opportunities of sea level rise, achieving sustainable fishery and aquaculture and fostering multifunctional resource use.

Meeting challenges and opportunities of sea-level rise

The sea has shaped our national character.
Consequently, one might expect, we are foresighted people,
have loose morals and are broad-minded.
That is, however, not the case.
The sea has made us,
but rather differently than one would expect.
The sea isn't our friend.
It's our mortal enemy'.
Godfried Bomans in: What is a Dutchman? (1999)

1 Returning ecosystem functioning to the delta

Estuaries form a natural and biologically productive interface between fresh water rivers and the sea. These morphologically unique systems of channels, shoals, sand banks and mud flats have a high productivity. The services of estuaries to the ecosystem are sky-high. Currently, Dutch hydrological engin-

eering constructions guide riverine water directly into the North Sea. The estuaries of Zealand are closed off to increase safety. Large quantities of nutrients in fresh water are discharged directly into the sea through the Nieuwe Waterweg. This situation leads to eutrophication and algal blooms both in the Delta and the North Sea. In this daring experiment it is proposed to return the ecosystem functioning to the Dutch delta by redirecting the outflow of the Rhine and Meuse rivers into the re-opened delta of Zealand. This allows for enhanced ecosystem services in the fresh-salt water gradient, creating economic chances for sustainable aquaculture and fisheries. Such a restructuring of the river outflow might also lead to more fish in the North Sea.

2 A wide and flexible coast

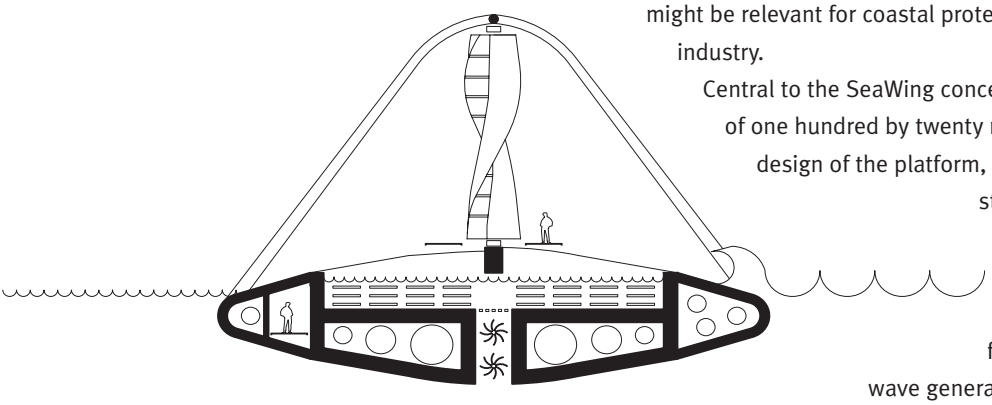
The current Dutch coastline reflects a balance between physical processes and man-made defence structures such as the Afsluitdijk in the North of the Netherlands and the Delta works. Now-a-days sand replenishment secures the North and South Holland sandy coastlines. The present sea-level rise, as well as the large number of man-made defence structures, has weakened the coastline. In this experiment, the current policy of sand replenishment is extended seaward. Large-scale sand replenishment and the concept of 'building with nature' are taken forward by creating a buffer zone of islands, sandbanks and lagoons along the Dutch North Sea coast. Man-made intertidal zones act as a safety zone for the present vulnerable coast, creates nature, increases the natural biological productivity and offers opportunities for multifunctional use. The Dutch hydrological engineering is stretched towards truly co-operating with the morphological processes in the coastal zone: eco-engineering rather than building rigid dykes.

Achieving sustainable fishery and aquaculture

'Dutch cookery writing is still dominated by the great tomes of cookery schools which are reprinted again and again, illustrating the Dutch conservatism. Yet, the Dutch continue to love their herring, as they have done for centuries, and make plain but good dishes of eel, cod and haddock. The influence of Indonesia is apparent in some recipes for curried fish.'
Alan Davidson, North Atlantic Seafood (2003)

3 SeaWing

The worldwide demand for food and energy is increasing. The 21st century is the century of ocean exploration and sustainable exploitation in order to meet these challenges. Therefore, new and innovative concepts are needed. SeaWing is such a concept. Basically it is a floating, compact, multifunctional platform with a sustainable production function. It combines energy genera-

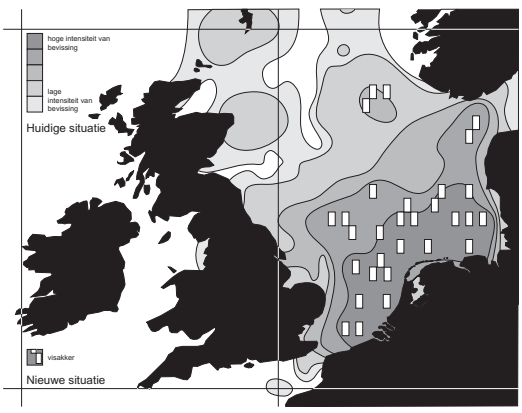


tion at sea with aquaculture. Moreover, SeaWing fleets might be relevant for coastal protection and the tourist industry.

Central to the SeaWing concept is a floating basin of one hundred by twenty metres. Due to the design of the platform, this basin is constantly filled with fresh seawater by wave action. As such SeaWing functions as a mobile wave generator. The water in the basin serves two functions: it generates electrical energy through a series of water turbines in the bottom of the platform and it serves as a scavenger for plankton needed as food for aquaculture activities. To generate energy SeaWing also uses wind turbines that form a curtain of vertical structures on top of the platform. Finally solar panels could also be used to increase energy production. Yet, the output of solar panels is still comparatively low. Part of the energy produced in this way is used for propulsion and trimming of the platform. The bulk, however, is used to produce hydrogen. Bacteria that use hydrogen and carbon dioxide produce additional biomass in a chemo-autotropical bioreactor. The biomass produced in this innovative way is added to the plankton as a hydrogen fertiliser to feed cultured fish and shellfish. SeaWing scavengers are compact and flexible. They could cross the North Atlantic Ocean in search of favourable weather conditions and plankton.

4 Fish fields

Fishermen consider the entire sea as their territory. They feel threatened by other emerging activities as offshore wind energy and marine protected areas. Catching plaice and sole by beam trawling yields some eighty percent of the catch by Dutch fisherman. Trawling is a rather destructive activity for the ecosystem. The bycatch is enormous: two to four kilo fish and ten to twenty kilos of other bottom organisms. The question is how can beam trawling be more sustainable? Is there a way out? Fishermen



themselves claim that beam trawling the bottom of the sea increases the local productivity. They say that the amount of worms, the favourite dish of plaice and sole, increases in the furrows of trawlers. If this is true, 'offshore farming' in fish fields could be a smart option. It might be economically and ecologically more attractive to concentrate beam trawling in specific fish fields. To improve the understanding of trawling, a seven to ten years comparative study of fish fields using different flatfish fishing techniques, as well as areas that are closed off for any activity at all, is proposed.

Achieving sustainable fishery and aquaculture

International perspectives

Fish farming has been around for a long time. From ancient times, various peoples have reared certain fishes in controlled environments. The Romans, for example, had special ponds where they reared moray eels, which were considered to be culinary favourites, while carps and goldfishes have been kept for centuries as ornamentals in China.

The Dutch efforts and ideas for a sustainable use of ocean resources and especially fishery and aquaculture fit in an international trend of experiments to improve the fish and seafood production. A number of foreign experiments are also described in the Sea Ahoy! study. These experiments are:

- The combination of offshore wind farms with aquaculture (mussels, oysters and algae) off the German coast.
- The construction of artificial reefs in Veracruz, Mexico as Fish Havens for coastline protection, local fishery and tourism.
- AquaNet in Canada's Bay of Fundy is a research project in which co-cultivation of Atlantic Salmon, Blue Mussels and kelp occurs as a bioremediation for the salmon effluent.
- The Maine Lobster fishery in Maine, USA as a co-management based resource use.
- Seawater Farms, an Eritrean company that especially grows shrimps for European export, together with small amounts of fish for local consumption and glasswort and mangroves. The wetlands are used to purify the water before it returns to the sea.
- Examples of the integration of regional activities through industrial symbiosis to improve the recirculation of wastes in aquaculture are described from Denmark and Norway. In the Norwegian Tjeldbergodden Industrial Complex, among others, a turbot farm is operated.
- The Marine Steward Council, founded by the World Wild Live Fund and Unilever as a market-driven mechanism to encourage sustainable practices in the world's fisheries.

"Once we are confronted with problems (such as decreasing catches or pollution), we come up with smart interventions. Closing the sea for any resource extraction activity is giving nature a change again. In the mean time, we should develop for instance strategies for sustainable fishery."
Arjen Boon, Greenpeace the Netherlands

5 Fish bank for fresh fish daily

Small-scale coastal fishermen are loosing ground due to expansion and specialisation of North Sea fishery. The huge capital investments and the current EC quota system cause a lock-in towards up-scaling. As a consequence the market for mixed coastal fisheries delivering fresh fish daily is almost non-existent. In this experiment, the feasibility of a mixed coastal fishery, landing a daily fresh, seasonal product is being tested. Major challenge is to show that a mixed fishery delivering quality fresh products pays off better than the current focus on bulk and quantity. The proposed fish bank in this experiment, builds on the concept of Biesheuvelgroups that act as a co-management system in which the responsibility of quota is shared by groups of fishermen. A fish bank forms a central management system for quota of a wide variety of fish species that are bought and managed by the fish bank. The rights to fish are subsequently leased out to participants under certain sustainability conditions. In this way it facilitates the development of a mixed coastal fishery that lands on a daily basis fresh fish with a regional sustainability label.

6 Fish⁺PLUS

The most frequently used aquaculture systems are open cage structures. These compete with other user functions in coastal areas such as tourism, industrial activities and port facilities. Moreover, sewage, fertilisers and the use of medicines may pollute the coastal zone. Escaped cultured species may affect natural fish stocks. The open connection to the sea makes aquaculture itself vulnerable to algal blooms, parasites and fish diseases in the marine environment. A major environmental problem linked to aquaculture is that feed is still processed from fishes that were originally caught by industrial fisheries. A fact is, however, that the demand for fish will increase worldwide. Aquaculture is expected to be a major growth sector. Fish production in the Netherlands takes place onshore in 'closed' recirculation systems that purify the effluent water for re-use. Central to the Fish⁺PLUS experiment is to link onshore fish farming with the production of fish feed being algae produced in photobioreactors. These bioreactors purify the effluent water of the fish production and re-use the nutrients, which implies that the full production cycle takes place onshore. The closed system allows for envi-

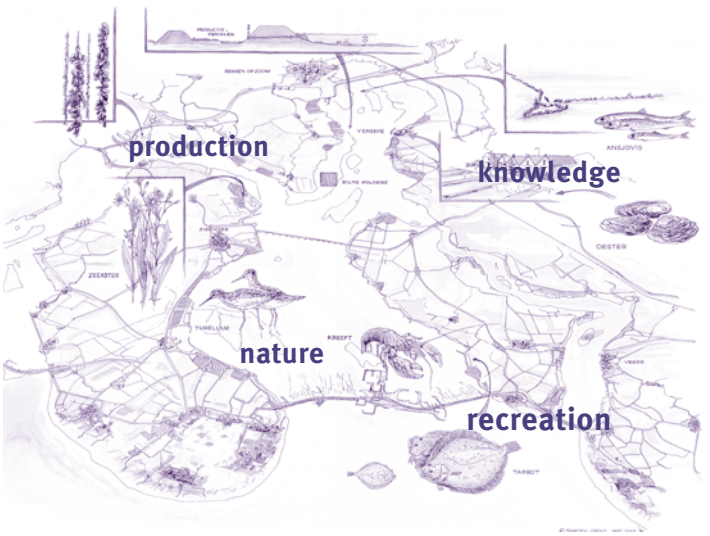
ronmentally friendly control. Food safety can be guaranteed to the consumer. In an industrial plant bioreactors and recirculation tanks are housed in the main building while a dedicated innovative solar system is placed at the rooftop and when necessary even at the rooftops of surrounding buildings. Glass fibre cables into the photobioreactors transport solar energy caught by solar lenses. Additional energy from cooling water of, for instance, power plants can also be used during winter months. Photobioreactors to grow algae with special characteristics such as a high level of polysaturated fatty acids allow for a special health quality of the fish products. Moreover, by changing the protein- and fatty acid profile of algae it even might be feasible to grow carnivorous fishes as vegetarians! So, in the double plus experiment a high quality product with an added health value, a warranted quality and a well-balanced product is grown in a sustainable way!

Fostering multi-functional resource use

The concept of a sea culture park means extensive harvesting of food at the salt and fresh water interface. In such a park, the marine-freshwater gradient is restored through innovative 'soft' hydrological engineering. This allows for salty nature development and harvesting of a wide variety of regional 'fruits de mer' and leads to a cottage industry that provides the local client with local products. The concept of a sea culture park also allows for flexible water management and recreational development. So, multifunctional resource use!

7 Sea-nergy in the Eastern Scheldt

Synergy is central to the sea culture experiment in the Eastern Scheldt. This estuary marked a transition in the Dutch policy towards sea defence. Instead of



"The trick is to combine creative thinking, technical and specialist knowledge in a Design Group. Participants should, however, not feel restrained by policy, administrative, technical, financial or legal conditions."
Esther Luiten,
foresight study project manager

closing the inlet entirely, a permeable dam was constructed, warranting both safety and preserving the estuarine characteristics. The Eastern Scheldt is internationally well known for its seafood delicacies, its Eastern Scheldt dam with Neeltje Jans and its natural values. In this experiment, a 'string of pearls' of food production, nature development, recreation and research is reinforcing the multifunctional character of the Eastern Scheldt inlet by constructing a new type of dykes. Sea-nergy builds on existing developments in Zealand such as the creation of: nature, a marine innovation centre in Yerseke, a sea cultivation research station, a visitor's centre for the National Park Eastern Scheldt and the use of hang cultures for mussel harvesting. The half-open Eastern Scheldt inlet is a first location in the Netherlands to experiment with an innovative 'natural dykes' concept. In this concept wide dyke zones replace traditional robust dykes and allow for multiple spatial use through cascades of advanced production techniques to provide a wide variety of seafood.

8 Salty Head with Silver Coin

Until some centuries ago the current Head of the North Holland province was characterised by mud flats and the Island of Wieringen. Regional economy and culture was driven by local, sea-oriented activities such as artesian fish and seaweed gathering for, among others, the construction of dykes and bird catching. A Viking treasure of silver coins signals that the region prospered. In the course of time, the Wieringermeer polder was created, so that the former Island of Wieringen disappeared. Now neatly arranged polders mark the landscape. Agriculture and bulb growing activities are predominant.
The Head of Holland is the ideal spot for a sea culture park focussing on 'salty horticulture' as a fourth source of agricultural income in combination with recreational development. A fresh-salt-water aquaduct will restore the estuarine character of the Oude Veer, also opening up possibilities for improved water management. Traditional salty social-cultural activities can be renewed in its former natural environment. Salty products such as the vegetables sea aster and glasswort, fragrant flowers, dried cudweed, salty spices, mussels, fish and quality fish from mixed coastal fisheries will be traded at the Wadden Market where culinary tourists buy these products.

9 Lely lagoon

The 1932 Afsluitdijk dramatically altered and shortened the Dutch coastline. It is an icon of Dutch hydraulic engineering, pioneered by Ir. Lely. The proposed Lely lagoon shaped as a water lily leaf is a sea culture park that combines food production, nature development, water management and the generation of sustainable energy. In fact it restores former fishery and nature functions of the region by creating a brackish water tidal area. Yet, safety of the rim provinces, the fresh water function of the IJssellake and nature values of the Wadden

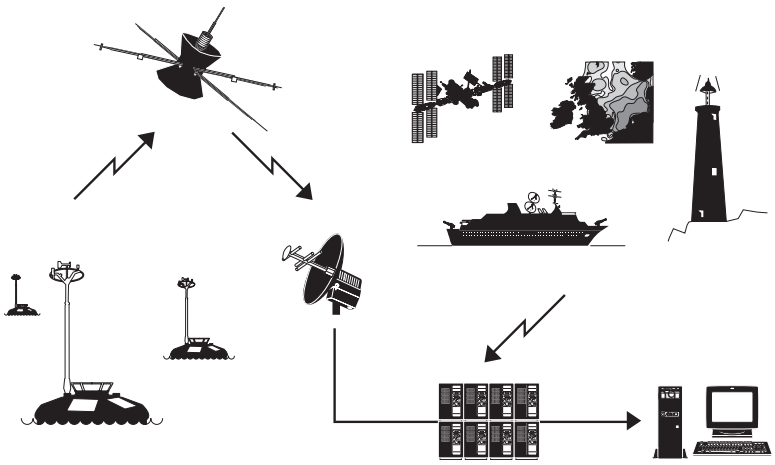
Sea will not be touched upon. Striking is the multifunctionality of the Lely lagoon. It allows for large scale growing of seed mussels, energy generation within the present Afsluitdijk, housing projects, migration of fish from the Wadden Sea towards the IJssel, Rhine and Vecht rivers, storage of fresh water from the IJssellake on top of brackish water in the 20,000 hectare lagoon as a buffer, marines for recreation, and the creation of nature.

Facing the applied science challenge

If we are to adequately address ocean issues at the local, national, regional and global levels, science cannot operate in isolation but will need to integrate more fully a response from society at large. There must also be changes in the way we regulate marine activities, in our social goals and our attitudes to ocean governance. If we are to make the right decisions we must understand how things 'work' in the ocean and how they interact; and we must recognize the role of the oceans in our life-support system and its value for humankind.'
IWCO report, The Ocean … Our Future (1998)

10 Ocean governance

Our understanding of the atmospheric process we call weather is reaching the limits of predictability. Weather forecasts are part of daily live. Complicated and chaotic information is given to the public in tailor-made, easy to understand forecasts in the media. Mostly one doesn't even know at all that these forecasts are the result of an annual investment of some two billion euro by the global community in a meteorological observing system. The benefits are not questioned either. 'Why do we not have such a system for the North Sea, the combined EEZs of seven highly industrialised and urbanised countries?' is the central theme of this experiment.



How can one strive for sustainability in a not well known and 'living system' as the sea? Our knowledge of the marine ecosystem is relatively limited. Our predictive knowledge of for instance fish stocks is even worse. To work towards sustainable use of the sea, a shared regional marine information system is crucial and similar to the one we have for weather forecasts. A North Sea marine information system should like a Matruska doll, be embedded in a larger scale North Atlantic system that is part of the Global Ocean Observing System, GOOS. It should also be linked to EuroGOOS. The components of a marine information system basically are: buoys measuring blue and green in-situ parameters, ships of opportunity, satellites for synoptic information and data exchange and computer models delivering a series of forecasts and special products. The applications are manifold. Well known examples are wave forecasts, the prediction of the trajectories of algal blooms in relation with aquaculture, forecast of bottom currents in relation with offshore oil and gas exploration and forecasts for insurance companies as well as oil companies and for sailing boats.

To facilitate this experiment it is proposed that the Dutch government is taking the lead. For this the present diversified responsibilities of a large number of ministries with regard to North Sea management should be brought together into a high level and powerful task force at the Cabinet level. Implementing a marine information system for the North Sea is a challenge for Dutch water managers and politicians in the 21st century.

11 BioTechOceanLab

Marine biodiversity surpasses the terrestrial one. An amazing variety of life forms that don't exist anywhere else on Earth live in the ocean. Of the ocean's roughly fifteen million species, only some 250,000 are described. So, these vast resources are largely unexplored. Both at land and in the sea the highest biodiversity is found in nutrient poor tropical areas such as rainforests and coral reefs.

The potential possibilities of developing for instance drugs from the sea are enormous. So far, terrestrial organisms and especially plants are mainly used by the pharmaceutical industry to look for new bio-active compounds. Once compounds are identified for specific diseases, and the formal approval procedure for a new drug is started the industry prefers chemical synthesis in order to guarantee a supply of high quality raw materials.

The marine environment is a huge living library for new medicines. Sponges for instance show a large cytotoxic activity. However, culturing in open water or yielding wild species with low percentage of compounds, do not fulfil the requirements to develop a new drug. It is neither a sustainable activity. Therefore, contained aquaculture of marine species or other bio-tech methods to grow the bio-active compounds are needed to develop and approve marine

drugs. But we do not really know which parameters are the key to the growth of such marine organisms. Ultimately the main problem in culturing marine species such as sponges and corals is the lack of understanding of the ecosystem, the interrelations and dependency with micro-organisms and the reproductive cycle of these organisms. Due to these uncertainties specialised biotechnology firms, instead of the pharmaceutical industry at large, may take up the quest for drugs from the sea.

The BioTechOcean Lab is basically a multidisciplinary high-tech innovation centre for research on potentially interesting marine organism and their environment. It operates at the interface of basic research, start-up companies and the biotechnology industry. It acts as a catalyst for research on compounds for the development of new drugs. But it also acts as an outreach and educational facility for raising awareness about the challenges and opportunities of the marine environment. Research is focussed on biodiversity hotspots and life in extreme environments such as hydrothermal vents and cold seeps. Sponges, snails, sea suirts, bacteria and fungi are the most promising organisms to study and to produce compounds semi-synthetically by GMO's, fermentation or in cell-tissues. The BioTechOcean Lab also functions as a business development centre that gives housing, facilities, advice, soft loans and venture capital to starters. Part of the income of the Lab is generated by the outreach activities and business contacts with zoological gardens.

Qua vadis?

Some 75 percent of the Netherlands is situated below sea level and about 66 percent, being the Dutch EEZ, is sea. The Dutch EEZ is just a bare ten percent of the North Sea, one of the most intensively used seas in the world. The North Sea is a fertile sea and a place with a rapidly growing number of diverse human activities. This also is reflected in the large number of organisations and stakeholders involved in North Sea policy making. In the Netherlands alone, all thirteen ministries and some 250 other stakeholders are currently involved in policy implementation. Yet, an integrated vision in which sustainable resource use is the leading concept is still lacking.

The *Dutch Sea Ahoy!* foresight study illustrates that the main challenge is to change threats and conflicting uses into opportunities. This study also is a plea for a more experimental approach, for a gradual ecosystem approach and for educating users, policymakers, administrators, managers and other stakeholders how to deal with uncertainties within the system. The presented experiments are visions of a future in which economical, ecological and social-cultural opportunities go hand in hand, moreover, this foresight study stresses that despite investments in technology and knowledge, in fishing gear, in production development and in market development, still little is known about the functioning of the North Sea as a system.

Editors

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Annexes

Information on the COS and the system of cooperating sectorcouncils in the Netherlands

The Consultative Committee of Sectorcouncils for research and development (COS) in the Netherlands is the collaboration platform for the system of cooperating sectorcouncils and other COS-members active in foresight. The COS is constituted by a framework law.

Sector councils comprise representatives from the scientific community, society and industry and the government. These representatives present an independent vision of the knowledge-needs and the priorities for strategic research in their respective sectors. Their vision is based on thorough studies and foresight activities, necessary to obtain a long-term perspective on societal and scientific trends. From a viewpoint of a necessary integral approach sectorcouncils are very often working together so as to consider one trend in coherence with another. Sectorcouncils also map out developments in science and technology and the implications for society.

Areas covered by the system are presently: spatial planning, nature and environment, rural areas and agriculture, health, technology, development assistance and (summer 2004) public administration, justice and security and education. The possibility of a sector council for Transport and Infrastructure is under investigation.

Functions of the COS are e.g. promoting a joint approach in foresight- and programming studies, organizing studies on the development of methodology, funded by the COS Coordination Fund (CF). Furthermore the COS sees to joint input in administrative consultations with ministries and other organisations.

For more information on the sector councils and the COS-projects please visit www.minocw.nl/cos

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Toekomstbeeld
der Techniek

The Netherlands Study Centre for Technology Trends (STT/Beweton)

The Netherlands Study Centre for Technology Trends (STT/Beweton) was founded in 1968 by the Royal Institution of Engineers in the Netherlands (KIVI). STT/Beweton has the following aims:

- To evaluate technological trends from the viewpoint of the engineering sciences and to explore their interaction with other developments in society as a whole.
- To give wide publicity to its findings as a contribution to a more integrated picture of the future of society in the Netherlands and elsewhere.

STT addresses itself to industry, government, science, and the interested layman.

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Innovation Network Rural Areas and Agricultural Systems

Innovation Network Rural Areas and Agricultural Systems stimulates, initiates, creates, and effectuates wide-ranging modernizations in rural areas and agricultural production, by bringing together representatives from industry, social organizations, academia and the government. In the same context, it also provides information via publications, consultations, and the media. By harnessing the resources of its network of approximately five thousand involved parties, Innovation Network Rural Areas and Agricultural Systems intends to achieve fundamental revolutions which will enhance both the vitality of ecosystems and people's quality of life. Rather than focusing on a single field, these reforms will solve several problems at a stroke. The complex problems affecting rural areas and agricultural production are often interlinked. Innovation Network Rural Areas and Agricultural Systems therefore aims to develop wide-ranging, novel concepts to achieve goals such as optimum logistics, sustainable land-use, sound animal husbandry, and the environmentally-friendly cultivation of vegetables under glass. The so-called Agro Production Parks represent one such modernizing concept. This involves the sustainable clustering of companies, which then produce and process food at a single location. At present, these activities are usually distributed throughout the country. One example of this practice is the rearing and slaughtering of pigs. Vegetables cultivated in greenhouses above the pig pens benefit from these animals' dung and rising body heat. What are the advantages of this approach? No cattle transports, no environmental burden for the rural areas, efficient use of energy, energy recovery, effective monitoring of animal welfare and animal health.

Internet address: www.agro.nl/innovatienetwerk.