

Land reclamation for coastal defence and tourism development, Køge Bay - DK

1. Policy Objective & Theme

- ADAPTATION TO RISK: Preventing and managing natural hazards and technological (human-made) hazards
- SUSTAINABLE USE OF RESOURCES: Preserving coastal environment (its functioning and integrity) to share space

2. Key Approaches

- Ecosystems based approach
- Technical

3. Experiences that can be exchanged

Moving the coastal defence seawards as a flood protection mechanism and, at the same time, providing quality tourism facilities.

4. Overview of the case

Coastal defence measures and tourism development have been combined in this example of the Beach Park at Køge Bay, south of Copenhagen. The Beach Park combines flood protection and the development of tourist infrastructure. It also serves to show how it is possible to work together with natural processes to create a stable and low maintenance-demanding structure serving the two purposes.

5. Context and Objectives

a) Context

Køge Bay, south of Copenhagen, is characterised by shallow water, offshore bars and barrier islands in front of lagoons. It is densely populated with the suburbs of Copenhagen located nearby. In the period 1965-1980, the build-up of the southern part of Copenhagen was explosive and 42,000 dwellings with the necessary infrastructure were built along the coast of the Bay. It is highly industrialized and receives wastewater from four municipal wastewater treatment plants and several industrial outlets. Nonetheless, there are valuable salt marshes and reed swamps present in the shallow lagoons. Furthermore, beaches in the bay are used for bathing and recreation for the city population. More than one million visitors per year use the facilities. The hinterland behind the bay is also prone to flooding, during winter gales, around the two rivers flowing into the bay. This flooding has a great impact on the inhabitants of the densely populated, Copenhagen suburbs. In order to secure an adequate flood defence mechanism, the Ministry of the Environment decided in 1975 to establish a beach park facility in Køge Bay.

b) Objectives

There were two objectives to building the beach park facility viz. to provide a flood defence protection for the hinterland and to provide a recreational area for the capital city population. It was also deemed important to set some of the land aside to create brackish lagoons.

6. Implementation of the ICZM Approach (i.e. management, tools, resources)

a) Management

The Ministry of the Environment was responsible for the Beach Park development.

b) ICZM tools

The beach park in the Køge Bay, south of Copenhagen, is an artificial landscape created in one of Northern Europe's largest land reclamation projects. The park consists of 7 km of beach, dunes, parking lots, access roads and kiosks. It is actually an expansion of natural barrier islands formed in the 20th century in the shallow bay. Between the beach and the hinterland are 6 lakes, shallow lagoon-like areas, which are connected with the Køge Bay by sluice gates. The park also includes small harbours. A system of dykes and sluices were built to regulate the river outlets to solve the problem of flooding.

The construction of the beach park was started in 1977 using extensive beach nourishment to create the new beaches. 5 million m³ of sand were needed for the alteration of the coastal profile. Of this amount, 3 million was gained from excavation in the lagoon areas and 2 million was dredged from the sea bottom of Køge Bay. The core of the artificial new coast is a 20 m wide dyke, built of sand with a height of 3 m. It was completed in 1978. Three groynes were built in order to keep the sand in place. The groynes made a parallel displacement of the coastline possible. By this manipulation most of the dyke length could be placed on the uppermost part of the initial barrier islands. This coastline adjustment also meant that the orientation of the new coast is perpendicular to the direction of the prevailing direction of the incident wave energy. This is very important to minimize the longshore transport of sand. To combat local erosion, a system of filter tubes was installed on the beach. They were designed to enforce the drainage of the beach during low tide and thus lead to more sedimentation during high tide.

During the following 1.5 years, details behind the dyke were completed. In those dyke sections where particularly intense traffic was expected, 1-2 m high artificial dunes were created upon the crest of the dyke. These dunes provide a buffer of sand and convey some naturalness to the artificial morphology. The dunes and their slopes were planted with *Ammophila arenaria* and the area behind the dune row was either planted with trees and shrubs, or sown with a mixture of grasses. After a period of establishment in 1977-1980, where the planted and sown areas were fertilized and controlled, the area was mainly given over to spontaneous vegetation developments. Finally, the harbour facilities were completed over a further 1.5 years.

In many places the landward side of the lagoons is preserved as salt marsh areas and reed swamps. To avoid stagnant water, automatic sluices were provided to force the water circulation in a one-way direction through the lagoons. These areas have deliberately been made difficult to access to secure quietness for the wildlife, especially the migrating birds which rest in great numbers at this locality.

7. Cost and resources

Total expenses (excluding the harbours) in 1980 prices was €21 million.

8. Effectiveness (i.e. were the foreseen goals/objectives of the work reached?)

There is no indication of structural retreat of the coastline. Erosion is seen in the north of the island belt, where a harbour with jetties causes leeside erosion but this is regarded as a local problem.

The following recreational facilities were created by the construction of the beach park: 5000 ha recreational area, 8 km of sandy bathing beach and 4 harbours with capacity for 5000 pleasure boats. Nature has been preserved and enhanced by the creation of the beach park. The creation of the dunes is considered a real success. The dunes on top of the dyke and in the sand depots today look very natural with their cover of aeolian-sorted sand caught by the dense carpet of lyme grasses. The dune forms have been modelled by wind. After two decades, the park has become a recreational area as well as a nature reserve with many different nesting and migrating birds.

9. Success and Fail factors

A very important explanation for the success of this large-scale coastal interference is the fact that its design was based upon

the character of the original morphology. The planning process involving the authorities and municipalities was considered a factor as well as how the beach park was financed – by Copenhagen city and some of the surrounding municipalities. This was quite forward co-operation given that the project had been planned in the nineteen thirties and was conducted during the nineteen seventies. Today more participatory planning instruments would have been used which could have avoided some of the early complaints. Another successful aspect has been the management of the vegetation: only typical vegetation from very similar locations was planted and managed in a way that keeps the park looking natural. However, it has been argued that it might have been better to manage the vegetation less and let free succession take place

10. Unforeseen outcomes

The planned 45 m broad beach, unusual for the landscape in Køge Bay, changed into a normal beach of approximately 10-15 m width over its whole length. It is bordered by an almost continuous and marram grass covered mobile dune ridge. A pre-condition to preserve the original vegetation in the lagoon is a frequent addition of salt water. Here some problems have arisen, as the mean water level in the sea Autumn is normally +0.3 m mean sea level. i.e. the level at which the sluices automatically close. Long periods with closed sluices have revealed that the river dykes are too low, and several times the water levels in the rivers have exceeded the spill-overs. In such situations the lagoons receive an undesirable amount of fresh water. A considerable accretion has taken place on a 3 km long coastal stretch southwest of the beach park. Several barrier islands and lagoons have emerged, and in some sections the coastline has been displaced more than 100 m in a seaward direction. The major disadvantage from this development is that sea weeds of different kinds are washed into the lagoons during storm situations and infect the air when rotting in the stagnant water. However, the recreation advantages are considered to be have over-riding importance.

11. Prepared by

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12. Verified by

It has not been possible to verify this case.

13. Sources

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- PROCOAST Final Report (2001) European regional development fund Interreg II C, Baltic Sea Region, Publisher: Schleswig-Holstein State Ministry of Rural areas, State Regional Planning, Agriculture and Tourism, Coastal Defence and Harbour Division, June.



Koge bay - Sistermans and Nieuwenhuis (186.5 KB) 