Beach nourishment as a successful measure against erosion, Sylt Island - DE

1. Policy Objective & Theme

- ADAPTATION TO RISK: Managing impacts of climate change and safeguarding resilience of coasts/coastal systems
- 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

- Integration
- Ecosystems based approach
- Socio-economic
- Technical

3. Experiences that can be exchanged

Solid constructions, bank revetment, groynes and sand nourishment as a means to protect the sand barrier island from erosion and thus the threats to the island's values was evaluated. The recommendations have to be adapted to slightly different conditions on other islands.

4. Overview of the case

The natural conditions of erosion were analysed, socio-economic status and measures to protect the west coast of the island Sylt from erosion were assessed. Sand nourishment was found to be an efficient way to protect the west coast from a further decline. It does not prevent erosion, thus sand nourishments have to be repeated when necessary because the sand depot has been depleted by storm surges.

5. Context and Objectives

a) Context

Sylt is a sandy barrier island in the North Sea. It is the most northern of the German Wadden Sea islands. The coastal zone is characterised by sand dunes, and at the west coast by sand dune cliffs (up to 35 m high, flattening towards the south) and sand beaches in front of the cliffs, that break some of the oncoming wave energy. Nonetheless, the 40 km west coast is very vulnerable to erosion. The east coast borders the Wadden Sea tidal flats.

Tides have an amplitude of 2 metres. Wave and tidal action continuously erode shore and foreshore and transport sediments to the northern and southern end, respectively, depositing them there (structural erosion). Severe storm surges even affect the cliffs and the Wadden sea side. Since 1928 the island is connected to the mainland by a railway dam. Both sides of the dam are sediment sinks where salt marshes are growing. About 21,000 people live on the islands 99 km2 (density 212 inhabitants/km2). The entire Wadden Sea is protected as a national park and biosphere reserve. Besides nature conservation the island is an important sea-side tourism and recreation spot. Fisheries and urbanisation are other factors that determine the island's characteristics. Damage to the coastal protection threatens the island properties. High population density and high economic values define a high risk potential in the central cities, the other parts are at moderate risk, though the recreational value is high. Therefore, current policies are “hold the line”. Recently, due to climate change scientific debates about a policy change towards a “protect-selected-area-strategy” started.

b) Objectives

The aim was to define affordable and efficient long-term protection of the west coast of the sand barrier island Sylt from the loss of values considering the different interests. Best practises for long-term coastal protection considering climate change effects were to be described.

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

a) Management

Today, sand nourishments are organized by the State Agency for Costal Protection, National Park, and Marine Protection (Landesbetrieb für Küstenschutz, Nationalpark und Meeresschutz Schleswig-Holstein) as the executing agency of the Ministry of Agriculture, Environment, and Rural Areas.

b) ICZM tools

The description of the risk situation and the analysis of the efficiency of different coastal protection measures can be used as a decision-helping tool for island communities and planners. The assessment study was based on an indicator list. For the development of policy recommendations a pressure-state-impact-response (PSIR) approach was adopted. The different measures analysed were solid constructions, bank revetment, groynes and sand nourishment. Sand nourishment had been started in 1972 in Westerland, since 1984 it is done along the whole west coast. Additional bio-technological measures to increase the stability of the dunes are the erection of sand trap fences and the planting of marram grass. The hard constructions had not stopped constant erosion, on the contrary wave reflexion on the walls and revetments increased beach erosion.

The status of the socio-economic situation and the different interests were taken into consideration. Also, regional interests were considered, since erosion, sediment-transport, and coastal protection measures can affect neighbouring islands as well due to changes in currents and sediment load. Sand nourishment turned out to be appropriate solution from a technical, economic, and environmental point of view. It does protect the coast line from decline, though it has to be repeated as soon as the artificial sand stocks are depleted. The sand is excavated with an automated suction dredge device from an area about 10 km west of the island shore from a depth of 14 m. At first, ships pump the sand to near-shore and fore-dune sand deposits. At high tides the sand is moved further up the beach with the help of shovel excavators and tubing. The sand nourishment activities are accompanied by sonar measurements of the near-shore seafloor and on the beach before and after nourishment activities. The deposits need to be replenished regularly. Each autumn the beach profile is measured by laser scanning from an airplane. No impact of the sand dredging on the island has yet been registered. However, long-term effects of sand extraction are not well known. Neighbouring regions are not affected by the activities. Sand nourishment creates wide sandy beaches increasing the recreational value.

7. Cost and resources

In 2008, 1.3 million m3 of sand were moved to replenish the deposits for a length of 5.7 km. This cost €6 million.

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

Sand nourishment started in 1972 and has been repeated at irregular or regular intervals. Hard structure protection of the west coast has been found ineffective in the long run. Even some negative effects have been noticed. The tetrapod groyne in the south protects the coast north of it but increases erosion downstream. The seawall at Westerland needs to be nourished to protect it from collapsing, and it causes lee-side erosion. The sand system of beach, fore-beach, and dune is kept intact by the sand nourishment and bio-technological measures. On the Wadden Sea side, storm surges lead to long lasting damage with poor recovery.

9. Success and Fail factors

Policies to “hold the line” by means of dykes started to falter in the 1950s. The policy changed to ensure similar security for all state dykes instead of building new ones. However, hard construction measures and engineering still dominated coastal defence policies until the 1980s. In the 1990s this attitude changed to use soft techniques based on more natural materials, such as sand nourishment. In 1995, a common salt marsh management plan was introduced by coastal defence and environmental authorities. Risk management will develop towards calculating risk from the probability of the occurrences of protection damage and the potential damage caused by a resulting flooding. Within the initiative “Coastal Protection of Sylt”, initiated by the managing state agency in Husum, an analysis of the latest developments and technologies in coastal protection had already been conducted and found sand nourishment an appropriate means. The “Generalplan Küstenschutz” (Coastal Protection Master Plan) stated costs of the measures that could be taken into the efficiency analysis in terms of costs and outcomes.

10. Unforeseen outcomes

Long-term effects of sand extraction are not well known. Solid protection measures were shown to fail on the long run and even had negative side effects such as increased lee-erosion.

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13. Sources

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