Beach nourishment as a successful measure against erosion, Rostock - 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 work west of Rostock, but eastwards they did not prevent erosion. Sand nourishment stopped the coastal decline there, at the same time increasing the attractiveness for bathing tourists. The recommendations have to be compared with the given natural and socio-economic conditions in other areas before applied.

4. Overview of the case

Hard constructions for the protection of a highly dynamic coast have not been sufficient to prevent coastal erosion. Sand nourishment in combination with marram grass planting in the dunes and maintenance of coastal forests behind the dunes was found to be an efficient way to protect the coast from further decline. Geo-textiles are used to increase protection at locations where dune ridges are narrow. Sand nourishments have to be repeated depending on occurring erosion and storm surges, on average about every 6 years.

5. Context and Objectives

a) Context

Rostock is the largest city (about 248,000 inhabitants) on the Baltic coast of the state Mecklenburg-Vorpommern in the north east of Germany and is one of the major seaports of Germany. It is located at the mouth of the river Warnow. Industry, transport, and energy are important sectors in the area due to the port. Fisheries is another relevant economy. Tourism and recreation are of economic importance as well. East of Rostock, the National Park “Vorpommersche Boddenlandschaft” dominates the coast. Many other natural areas of the coast could be conserved. Rostock is an urban area with many values. Flood-prone areas are not densely populated but encompass great economic values due to the harbour, therefore the area is ranked as a moderate risk e.g. the damage potential to Warnemünde is about €200 million. Nature conservation is not threatened by erosion.

The average erosion at recession sites of the coast of Mecklenburg-Vorpommern is about 34 m/ 100 years. Erosion (249 km) and deposition (26 km) processes characterise most of the southern Baltic Sea coast of Germany (the total outer coast of Mecklenburg-Vorpommern is about 377 km). West of Rostock a moraine cliff coast dominates while the Rostock-Warnemünde beach is a flat sand beach with dunes. The Warnemünde groynes were built from 1995 to 2000, those at the Markgrafenheide coast further east are mainly from 2005. Sediment transport is mainly wind and wave induced from west to east. Seiches

(wind tides) and storm surges can influence water levels by up to 3 metres, normal tides play no big role in the Baltic Sea. Before the shore-line was protected, strong storm surges could cause coastline recessions of about 10 metres. The highest water levels measured during storm surges were between 2,71 m and 2.83 m above mean sea level. In 1874 a storm surge caused a dune break at a length of 1,400 m.

b) Objectives

Affordable and efficient long-term protection of the flat sandy coast of Rostock from the loss of values considering the different interests is the aim of the coastal protection measures. Climate change effects are taken into account.

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

a) Management

Sand nourishment and other coastal protection measures are executed by the regional Offices for Environment and Nature (StAUN) in Mecklenburg-Vorpommern. Additionally, the Division Coast of the State Office for Environment and Nature Rostock is responsible for planning, evaluation, and assessment of all coastal protection measures in the state Mecklenburg-Vorpommern. The state authority for coastal protection is the Ministry for Agriculture, Environment, and Consumer Protection Mecklenburg-Vorpommern, department 7 – Water and soil. The assessment of environmental impact and other spatial planning approval and assessment lies with the State Office for Environment, Nature Protection, and Geology.

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-making tool for other city beach 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 has been adopted. The different measures analysed were a seawall (built in 1914, Warnemünde West), revetment (constructed of different materials at Markgrafenheide from 1963-68), groynes (at Warnemünde built from 1995-2000, at Markgrafenheide mainly built or reconstructed in 2005), and sand nourishment. Sand nourishment was started in the early 1970s. The status of the socio-economic situation and the different interests were taken into consideration. Regional neighbouring interests were not affected. Sand nourishment combined with the described biological measures turned out to be an 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.

At Warnemünde, since 1990, sand from the accumulation zone west of the harbour entrance is used to feed the dunes (1996 1,750 m3, 2000 1,785 m3 + 2,861 m3 , 2006 34,000 m3). East of the harbour entrance, at Hohe Düne, sand from land and sea are used for dune and beach nourishment (1999 12,622 m3, 2004 60,445 m3). At Markgrafenheide beach nourishments are done with sand from the sea floor (1996 140,350 m3, 2003 660,000 m3). Sand from the accumulation zone is moved with shovel excavators. The sand for beach nourishments is excavated with an automated suction dredge device from a depth of 10-15 metres. The sand needs to be of mixed grain size not containing mud or boulder clay, and without dangerous remains of ammunition or toxic substances. Therefore, deposits for such sediments are explored and reserved for dune nourishments. Environmental, morphological, hydrological, and geo-chemical effects of the excavations are monitored. In Warnemünde, in 2005, geo-textile containers were used to line the landward dunes' bases as a last protection line in case of severe dune erosion. This is a new and additional measure for areas with narrow dune ridges.

7. Cost and resources

Each year about 800,000 m3 of sand are excavated in Mecklenburg-Vorpommern to protect the coast from erosion; the measures cost about €5 million per year. Sand from the sea floor is cheaper than sand from the accumulation zone because larger masses can be handled in less time. The groyne system of Warnemünde (17 groynes of about 500 poles) cost about €2.1 million, dune feed ups 1992, 2000, and 2006 of about 92,000 m3 sand from the accumulation zone cost about €370,000, the geo-textile protection was constructed 2005-2006 (2 sites with a total length of 600 m and 8,455 sand containers) and cost about €432.000.

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

Sand nourishment was started in the early 1970s. Therefore, the experiences with the different measures were based on long-term experience. Sand nourishment was necessary in high erosion areas to stop coastal decline. In 2009, sand nourishment is still seen as the most efficient measure economically with least environmental impact to protect the coastal dunes from erosion and decline.

9. Success and Fail factors

Natural coastal dynamics are acknowledged in Mecklenburg-Vorpommern. The national park areas, areas where no protection of built-up areas is a legal requirement, and natural cliff sites are left to natural coastal dynamics. Maintenance is dynamic following the notions “hold the line” with “limited intervention” if possible. Of 377 km outer coast only 120 km of low-lying and 15 km of cliff areas are protected by hard measures, less than 50%. Hard constructions are the exception: they are not a long-term solution, are expensive, and hamper tourism, ecology, and landscape aesthetics. Sand nourishment creates wide sand beaches increasing the recreational value of the beaches.

10. Unforeseen outcomes

Long-term effects of sand extraction are not well known. In Warnemünde further protection from storm floods is needed at the river and harbour side of Warnemünde, different types and combinations of hard constructions are planned that are suitable for traffic lines (streets, train, harbour, promenade) and integrate into the image of the city.

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13. Sources

- Eurosion Case Study Rostock (Germany). Sistermans, P., and O. Nieuwenhuis, DHV group.
- http://www.regierung-mv.de/cms2/Regierungsportal_prod/Regierungsportal/de/lm/Themen/Wasser/Kuestenschutz/index.js
- Küstenschutz durch Sandaufspülungen an der Ostseeküste Mecklenburg-Vorpommerns (2002). Staatliches Amt für Umwelt und Natur Rostock, Abteilung Küste.
- Living with coastal erosion in Europe: sediment and space for sustainability - A guide to coastal erosion management practices in Europe (June 2004). National Institute for Coastal and Marine Management of the Netherlands (RIKZ), EUCC - The Coastal Union, IGN France International, Autonomous University of Barcelona (UAB), French Geological Survey (BRGM), French Institute of Environment (IFEN), EADS Systems & Defence Electronics
- Regelwerk Küstenschutz Mecklenburg-Vorpommern (2009). Abteilung Küste des Staatlichen Amtes für Umwelt und Natur Rostock.
- Staatliches Amt für Umwelt und Natur Rostock - Abteilung Küste: http://www.staun-mv.de/cms2/StAUN_prod/StAUN/de/ro/Aufgaben/Abteilung_K/index.jsp
- Sturmflutschutz Warnemünde/ Außenküste 2005 (2005). Staatliches Amt für Umwelt und Natur Rostock, Abteilung Küste.
- Sturmflutschutzsystem Warnemünde / Schutzabschnitte 9 und 10 - Hansestadt Rostock. Staatliches Amt für Umwelt und Natur Rostock, Abteilung Küste.
- www.eurosion.org

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- 2002_Sandaufspuelung_01_02 (1.52 MB)
- 2005_SFS_Wmde_Geotextil (897.21 KB)
- Faltblatt SFS Warnemünde Online-Layout (566.44 KB)