

Sand Nourishment

A flexible and resilient, adaptive coastal defence measure

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Introduction

In sandy coastal areas, sand nourishment can be considered as an efficient measure to preserve the shoreline and safeguard coastal functions such as recreation and nature. Nourishment is the supply of sand to the shore, to strengthen the coastal profile and add sediment to the littoral budget. Commonly the sand is extracted from the deeper sea bottoms, which may have large reservoirs of suitable sand. In coastal, deltaic areas where the marine sands may be too fine of structure, the use of coarser grained river sands might be an option. This latter option is being explored for the Romanian coast. The sand is usually nourished on the beach, although increasingly in the Netherlands on the foreshore. As the cause of erosion remains, the nourished sand is eroded over time. It is thus inherent in the nourishment concept that the nourished sand is gradually lost and that nourishment requires a long-term maintenance programme. How long a particular amount of supplied sand will endure depends on the forces of nature and coastal characteristics. These need to be thoroughly understood.

Monitoring

A dynamic coast needs intensive coastal surveying. This to ensure proper decision making regarding the preservation of the coastline and coastal zone and to safeguard economic development and associated large capital investments.

The Netherlands has a 350 km coastline length (as the crow flies). About 1600 coastal profiles are yearly surveyed since the 1960s. However the position of the Low Water line, High Water line and dune foot has been monitored already since the mid 19th century. Efficient survey systems (Figure 1) and data-base management allows for a quick process-time and in few months time, the so-called Kustlijnkaarten (Coastline-Maps, see CCC III-3-2-1) are produced.

These results are used each year for:

- 1) Identifying the erosion hotspots;
- 2) Indicating the sand nourishment locations;
- 3) Estimating the average life-time of a sand nourishment for a particular coastal stretch;
- 4) Analysing the economic cost and benefit for each stretch;
- 5) Evaluating the effectiveness of the national sand nourishment scheme and are used for five-year reporting to the Parliament.

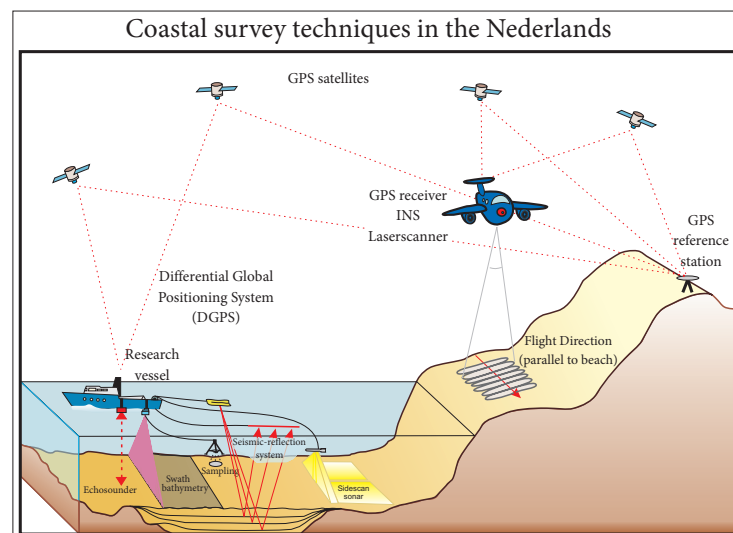


Figure 1: Airborne Laser Altimetry & marine multiple Sounding are modern survey techniques and systematically applied during the yearly monitoring of the 350 km long coastal zone of the Netherlands.

In 2009, a six years research programme began to assess in more detail the impacts and opportunities of nourishment for the coastal ecosystem. This programme covers the whole coastal zone, including the foreshore and the dune area. The programme will result in recommendations for an ecological optimal approach to nourishment.

The coastal manager optimises the coastal defence measures in line with the identified policy goals (Ministry V&W, 1990 – 2005) by means of coastal monitoring and applied coastal research. The development of data sets as well as morphological models supports the analysis and are important tools which contribute to continuous improvement of the way the nourishment schemes are executed.

Efficient method and its effects

In the Netherlands coastal nourishment proved to be successful and efficient. It contributes to a major reduction in maintenance costs of the coastal protection when compared to hard defences. Moreover, it also has benefits for other coastal functions, like recreation and nature conservation. Nourishment is a sustainable method, as it fits within the natural processes of sand transport and sedimentation. The resilience of coastal systems is safeguarded or can even be enlarged.



(photo: //beeldbank.rws.nl, Rijkswaterstaat)



(photo: Van Oord)

Sand nourishment in progress: rainbow nourishment on the fore-shore is a method increasingly showing its efficiency and is based on many years of special morpho-dynamic surveys.

It is widely considered that the use of sand is a better alternative than the construction of hard structures, for instance groins and dams, to protect a sandy coast. This is not only from an ecological perspective but also from an engineering point of view. The use of sand causes less serious side effects in the longer term than concrete structures. However, even though nourishment may be the best option from the ecological point of view, it also brings about some changes to the sandy ecosystem. These are being monitored to determine the recovery time on the locations of the sand extraction and nourishment sites.

The nourishment influences the morphology of the foreshore, beach and the fore-dunes. In the Netherlands not only 6 million cubical metres of sand is annually supplied to the beaches and in the near shore zone, but also about 5 million cubical metres in deeper water (up to 8 meters below MSL), in order to compensate the effects of sea-level rise. After 20 years of dynamic preservation of the coastline, the policy is changing into one of compensation the erosion in the coastal foundation, in the deeper part of the coastal profile. New special dredging techniques and contracts are then required.

The 'Sand Engine'

In recent years, the possibilities of using very large nourishments as a new strategy for coastal management are being discussed. An example is the innovative pilot project 'the Sand Engine' in front of Delfland in the Province of South Holland, the Netherlands. The pilot consists of depositing a large amount of sand (21.5 million m³ - 2011) in a depot just off the coast that will serve a multitude of functions: coastal protection, nature and recreation. The idea is that the natural longshore sediment transport processes will gradual redistribute the sand along the coast towards the North leading to coastal growth and protection and thus increasing space for coastal development (Province of South-Holland, 2009). The pilot Sand Engine will be accompanied by monitoring and research. If this pilot

proves to be effective, then this method of creating large-scale coastal sand buffers can be applied in the future.

This will help to reinforce the coast providing greater resilience and a more flexible way of accommodating the potential impacts of climate change, particularly accelerated sea level rise and increasing storminess. It is a no-regret measure, to be applied after the impacts of climate change are starting to become visible.

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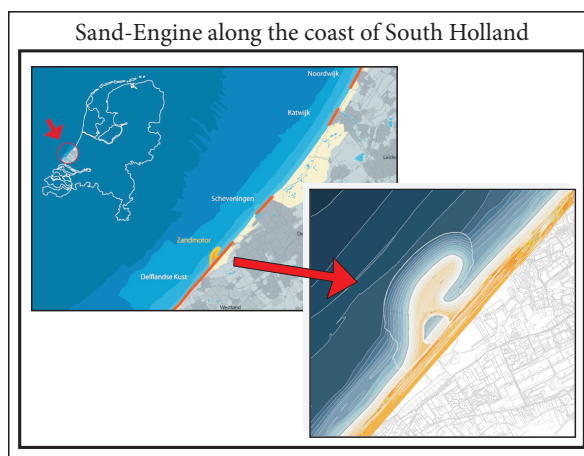


Figure 2: The large Sand-Engine of along the coast of South Holland will act as a huge sand buffer, an artist impression. (source: Sand-Engine - Provincie Zuid-Holland)

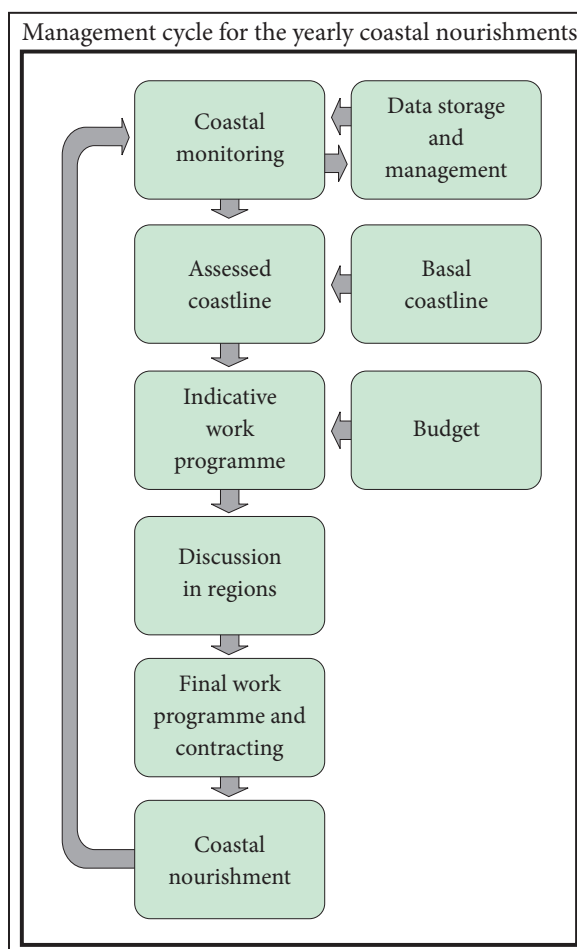


Figure 3: Management cycle for the yearly coastal nourishments; monitoring, data management and analyses are important elements.