Building with Nature in Wadden Sea Ports

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EcoShape Building with Nature Programme

- **EcoShape** is a Dutch consortium of private parties, government organisations, research institutes, universities and NGOs founded in 2008.

- They carry out the **Building with Nature** (BwN) innovation programme to test and develop a new design philosophy in hydraulic engineering that utilizes the forces of nature, thereby strengthening nature, economy and society.

- One of the cases within the BwN Programme concerns the **Wadden Sea Ports** and is carried out in co-operation with the Programme Towards a Rich Wadden Sea and the Dutch Programme Wadden Sea Ports since 2012.

Smart design for sustainable port development
Dutch Wadden Sea Ports

Wadden Sea
World Heritage

Harlingen
Delfzijl
How did the Harlingen project start?

1. Large maintenance dredging volumes in the Port of Harlingen (~1,2 million m³/y).
2. Close-by dredge disposal locations, possibly leading to high return flow of sediment into port.
3. Local nature organisation desired expansion of salt marshes.

1+2+3 gave the idea to bring dredged sediment to salt marshes.
A ‘mud motor’ was tested to promote the growth of salt marshes acting as sediment sink.
Beneficial use of dredged sediment to enhance salt marsh development by applying a ‘Mud Motor’


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Highlights

- Salt marsh sediment dynamics increases with a well-designed Mud Motor.
- Small salinity gradients can significantly affect mud transport fluxes.
- The success of a Mud Motor is highly dependent on wind and wave forcing.
Lessons learned from the Mud Motor

- Environmental regulations prescribe particular seasons and time slots for the disposal of dredged sediment that is affecting the strategy for mud disposal.

- Longer dredge cycle times and a loss of flexibility in temporal windows for the disposal are putting the contractor under higher strain and this leads to considerable extra costs.

- The feasibility of a Mud Motor depends on an assessment of additional cycle time for the dredger (extra costs), the valuation of salt marsh growth (nature profits), reduced dredging volumes in a port (reduced costs), and many practical issues (depth at the disposal location, time slots, natural dynamics).
Suitable Mud Motor locations

- Target at salt marshes that are end-stations of sediment transport, for instance at the landside of a bay;
- Particularly bays that have a riverine freshwater outflow, which enhances sediment transport towards the marsh.
Delfzijl Marconi case study
Salt marsh development is tested in field-scale plots with various clay percentages, and with / without seeding of pioneer plants.
Height measurements

A. Subsidence
B. SEB: Sedimentation-Erosion Bar
C. SED: Surface Elevation Dynamics
D. LiDAR UAV
E. RTK-DGPS
Ongoing work: monitoring

- LiDAR drone (cover), RTK-DGPS measurements (channels).
- Sedimentation-Erosion Bars (27 stations), Acoustic Surface Elevation Dynamics sensors (6 stations).
- Vegetation cover, composition and biomass (147 plots).
- Sediment grainsize composition (27 depth profiles).
- Microphytobenthos cover (27 stations).
- Seed bank in the added clay.