LARGE-SCALE SAND NOURISHMENT STRATEGY OF THE DUTCH COAST; A SYSTEMS APPROACH

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Coastal policy in the Netherlands: maintenance by sand nourishments
In 1990, the Dutch Government adopted the national policy of "Dynamic Preservation" aimed at a sustainable preservation of safety against flooding and of values and functions in the dune area. Acknowledging sand as 'the carrier of all functions', the principle intervention procedure is nourishment of sand, making optimal use of and providing optimal space for natural dynamics (hence Dynamic Preservation). The implementation of the policy was guided by the definition of tactical objectives at different scales, i.e. preservation of residual dune strength at the small scales, of the basal coastline at medium scales and of the coastal foundation at large scales. The total yearly averaged nourishment volume since 2000, is 12 million m^3 of sand.

Upscaling of nourishments
The latest evaluation of the Dynamic Preservation policy shows that coastline preservation is successfully accomplished. However, with respect to the objective of maintaining the coastal foundation, evaluation was hampered by the lack of a clear benchmark. Regarding a recent update of the sand balance of the Netherlands coastal system, the conclusion might be that in this respect, the policy until now has failed: the update indicates a yearly deficit in active sand volume in the coastal foundation of ca. 20 million m^3, at the present rate of sea level rise of 2 mm/year. The objective to preserve the sediment balance of the coastal foundation would require a raise in yearly nourishment budget from 12 to 20 million m^3/year. In a study on climate adaptation of the Dutch Delta, the Delta commission suggests a raise of nourishment budgets up to 85 million m^3/year until the year 2050, considering an extreme sea level rise of13 mm/yr.

Design aspects of a large-scale nourishment strategy
In current discussions on an appropriate large-scale nourishment strategy, the dominant aspects relate to the basic questions: How much, where and when, how and who is responsible? Each of these questions will be briefly elaborated, indicating the major issues, arguments and approach.

How much?
The large-scale objective of the Dutch nourishment policy to maintain the coastal foundation, aims to preserve morphological boundary conditions for the coastal system as a whole, in order to allow it to grow with sea level. Thus, it is very important to define the limits of the coherent active coastal system at a larger time scale: coastal zone, tidal inlets and back barrier systems together. Then a decision has to be taken either to be reactive (or adaptive) to the rate of sea level rise, or to be pro-active to an estimated future increase in rate of se level rise.

Where, When and How?
Next discussions concentrate on the optimal distribution of nourishments sands both in space and in time. Since1990 in the Netherlands, the nourishment distribution has been governed by the definition of a reference coastline and a yearly nourishment scheme, predominantly consisting of shoreface nourishments with typical sizes of200 – 400 m^3/m. To investigate the effects of downscaling the frequency and of up scaling the intensity, an experiment was started in 2011 with a mega-nourishment of 10,000 m^3/m ("Sand Engine"). In parallel, discussions are ongoing to experiment with nourishments at sea dykes and nourishments of tidal flats in ecologically valuable areas in Wadden Sea and Delta.

Who?
The need for upscaling of nourishments is related to the governments (large-scale) responsibility for sustainable preservation of functions. Preservation of the active sand volume of the system is primarily the government's stake. The distribution of the volume affects stakes at all levels, national, provincial, regional and local. Taking the large-scale requirement for upscaling of the nourishment volume as a starting point, active involvement of all stakes in the design process of the distribution scheme may enhance integration between sectors.