

Which ecosystem services can a dune-in-front-of-a-dike deliver?

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² IMDC, Van Immerseelstraat 66, 2018 Antwerp, Belgium

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1. INTRODUCTION

Ecosystem services (ES) – nature's benefits to people – are produced by biotic and abiotic processes, habitats, species and interactions between them. One of the main arguments for choosing soft coastal defense measures are their perceived benefits in terms of ES. Soft defense measures disturb natural processes much less than hard engineering structures and provide habitat, creating opportunities for ES. Nature-based solutions take one step further by making use of the natural processes to safeguard the supply of ES also on the longer term. Nature-based solutions are usually more expensive to build than hard engineering infrastructure and traditional beach nourishments. Only if the added benefits in comparison to its alternatives can be made explicit, nature-based solutions will be in for the long term. This presentation presents the results of an analysis of different ES of a dune-in-front-of-a-dike in the Netherlands and critically discusses potential benefits of nature-based solutions in relation to natural dynamics.

2. METHOD

The results of an ES quantification of one nature-based solution and one natural system are presented: a dune-in-front-of-a-dike combined with tidal marsh development on the island of Texel in the Netherlands (constructed in 2019) and a dynamic dune system with no obstruction of sand transport in De Panne (hypothetical scenario). Each case is compared to an alternative situation, i.e. restoration of the traditional asphalt and concrete dyke and situation today with presence of a dyke in front of the dune obstructing the natural process of sand transport (respectively).

The approach for quantifying ES was similar for each study and consisted of:

- 1) Identification of changes in habitat (using NATURA2000 habitat classification and land use);
- 2) Biophysical quantification of ES for each habitat type (e.g. rates of nutrient cycling). This step is based either on local data or else values found in literature;
- 3) Each ES was attributed a monetary value using values from literature (local + benefit transfer);
- 4) The sum of ES (expressed in € per year) was made for each case study and compared to the ES of its alternative.

For the dune-in-front-of-a-dike an additional comparison is made including also the costs for construction and maintenance, allowing for a cost-benefit analysis.

3. RESULTS

The changes in ES of each case compared to its alternative are presented. The results show that the dune-in-front-of-a-dike solution generates more economic benefits in terms of ES than its traditional coastal safety counterpart, and that the initially higher costs for construction and maintenance are compensated by these yearly produced socio-economic benefits. For the comparison between a natural, dynamic dune system and a system with obstruction of sand transport, it was revealed that the dynamic system is capable of providing more ES than the 'fixed' dune system. The additional ES benefits are on account of recreation and coastal safety maintenance on the longer term (growth of dune with sea level rise). Recreational value was higher because people appreciated the typical dynamic dune landscape with patches of marram grass and bare sand and the presence of biodiverse dune slacks more than habitats of older successional stages (e.g. dune scrub) as dominant in the 'fixed' dune system.

4. DISCUSSION

The results show the potential value of nature-based solutions to contribute to human well-being and to provide economic benefits for different stakeholders. However, the study on dune dynamics shows the crucial role of certain ecological processes in the production of ES, and the potential loss of ES if these processes would not be present.

ES assessments are often performed for a given state in which the ecosystem is assumed to evolve with time. This assumes that the essential natural processes that are required to achieve that evolution are actually occurring. Not taking into account these processes may lead to an overestimation of the capacity of the socio-economic value of nature-based solutions. This may have important consequences such as an undermining of the growing support base for nature-based solutions and non-sustainable design of nature-based solutions. A challenge lies in taking these processes into account in ES assessments, and this is especially important in highly dynamic systems such as the coastal zone.



Figure 1: Expected ES impacts at the dune-in-front-of-a-dike at Texel (Fordeyn et al. 2019)

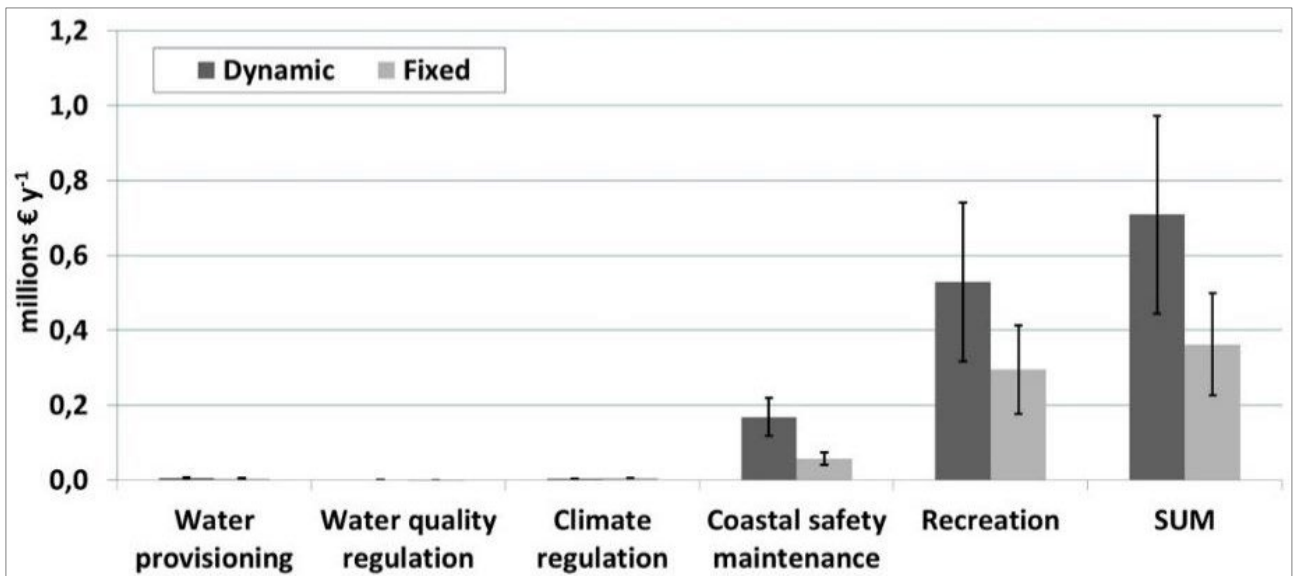


Figure 2: ES in frontal dunes at De Panne, for a dynamic dune system with continuous sand supply and a fixed dune system with obstruction of sand supply (Van der Biest et al. 2017)

5. REFERENCES

- Fordeyn, J., Van der Biest, K., Lemey, E., Boerema, A., Meire, P. 2019. An ecosystem services assessment of the Prins Hendrik zanddijk. *Terra et Aqua* 157, 31-46.
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