High-level business cases

Overview of 10 initiated business case developments across NSR

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Building with Nature Business Guidance Report

Deliverable 4 of Work Package 5 - Upscaling: business case development and opportunity mapping, part of the INTERREG Building with Nature project.

http://www.northsearegion.eu/building-with-nature/

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INTERREG Building with Nature project

The INTERREG Building with Nature (BwN) project demonstrates BwN solutions that utilize natural processes to deliver flood risk and coastal erosion management whilst enhancing ecosystem services. The overall objective of the INTERREG BwN project is to make coasts, estuaries and catchments of the North Sea Region more adaptable and resilient to the effects of climate change through the use of BwN measures. INTERREG BwN creates joint transnational monitoring programmes, uses state-of-the-art analysis methods, develops improved designs and business cases for BwN solutions.

This report is a deliverable of Work Package 5 'Upscaling: business case development and opportunity mapping'. The objective of WP 5 is to: 1) show available methodologies for business case development and valuation; 2) provide guidance for BwN concepts to approach business case development; and 3) to demonstrate opportunities of BwN by giving good examples of business cases for BwN. This report brings together 10 high-level business cases that are initiated across the NSR by the INTERREG BwN partners.

Project website: https://northsearegion.eu/building-with-nature/

Introduction

Aim

In light of general ambitions for scaling up investment in NBS throughout the globe including in the EU, in this document we showcase experiences in setting up BwN projects from 10 BwN projects in coastal and fluvial ecosystems in the North Sea region. We discuss why these projects were initiated, what their goal(s) is, what criteria played a role in the decision to select a BwN approach; and these projects were funded, financed and contracted. When applicable, the upscaling potential of the BwN solution applied in each case is discussed.

10 case studies

	Case Location	Country	Type of Project
1	Nordkystens Fremtid	Denmark	Coastal
2	Domburg	Netherlands	Coastal
3	Lange Oog	Germany	Coastal
4	Ameland	Netherlands	Coastal
5	Lodbjerg	Denmark	Coastal
6	Munnikenland	Netherlands	River
7	North Jutland	Denmark	Coastal
8	Raan	Sweden	River
9	Sylt	Germany	Coastal
10	Oostende	Belgium	Coastal

We hope these cases provide the reader with inspiration on how to build a business case – i.e. convince stakeholders, decision makers, financiers – for BwN.

Approach

These cases were developed in correspondence with case owners involved in the Interreg BwN North Sea Region project, making use of a standardized questionnaire form – see appendix A.

Business case development in BwN

The description of the cases follows the steps for business case development in BwN context as outlined in the Interreg Business Case Guidance document. In short, these steps include a systems analyses to identify potential BwN solutions; a decision making support process to substantiate the rationale for BwN; a design optimization phase; and the implementation phase including financing and contractual arrangements.

1. **Scope and context:** Identify key societal challenges for which BwN could pose a solution. Due to the nature of BwN these solutions are particularly suited to contribute to multiple goals/ societal challenges at the same time, other than e.g. conventional single-purpose solutions. In a coastal/ river context, this could be e.g. flood risk safety, erosion reduction, landscape amenities or biodiversity.
2. **Systems analysis:** Analyse the physical, socio-economic and institutional system to identify potential regular and/ or BwN solutions which would address the challenges identified in Step 1.
3. **Selection of preferred alternative:** Select the preferred alternative based on supporting analysis, including e.g. environmental and social impact assessment, cost-effectiveness analysis and social cost-benefit analysis – in the latter with particular attention for the value of additional benefits offered by BwN.
4. **Optimize design:** Optimize the design of the preferred alternative to increase the expected delivery of (co-)benefits and reduce uncertainty.
5. **Implementation:** Explore financial and contractual arrangements to facilitate implementation.

Throughout all phases, stakeholder engagement is key in ensuring public support, optimization of design and feasibility and sustainability of implementation.

Lessons learned

Overall, it is notable that the majority of cases are a pilot – at least one of the goals of doing the project is knowledge development on BwN. As such, in most cases there was no elaborate project definition and selection phase on a regular public investment basis, and no need for a clear business case to demonstrate their viability. Funding comes from public entities, often at least in part from innovation budgets; no external financing is used, as in most cases public budgets are sufficient in the North Sea region to cover required investment costs. As such, the scaling up potential depends on the physical applicability of the concept in other locations of the country, and on the proven effectiveness in meeting project goals (e.g. flood protection standards). Because of the pilot character and knowledge development aim of most cases, in particular physical and environmental systems analysis ex-ante, as well as ex-post monitoring is often quite well arranged. This pilot character may also be an explanation for the fact that in most cases contractors have relatively short contracts (1-5 years) with little room for innovation by the contractor.

1 Denmark – Nordkystens Femtid

1.1 Introduction

1.1.1 Project description

The Project "Nordkystens Fremtid" is located at a 60 km long coastal section between Hundsted Port and Helsingør North Port in the province of Zeeland. The north coast is exposed to servere erosion pressure due to chronic (ongoing) and acute (during flood events) erosion. The north coast cannot generally be regarded as free nature due to human impact in the coast's natural dynamics. However, there are some natural coastlines between Liseleje and Tisvildeleje, Heartherhill, Trillingerne, Smidstrup Strand, Dronningmølle, Hornbæk Strand and partly along Hornbæk Plantation. The natural coastlines cover approx. 15 km.

Status

Previous coastal protection efforts on the North Coast have primarily included hard coastal protection measures. Only in some cases, e.g. Liseleje sand nourishment is carried out on the north coast. In this context, the project Nordkystens Fremtid is a large scale project which requires a lot of planning. The project implementation is scheduled to last until 2021, and there are several elements that will fall into place over the next few years before a final model for securing the coast is in place.

In 2015, the technical project was launched. The purpose of this project was to show if there was any base for securing the coast with a combination of hard and soft coastal security across municipal boundaries. It should also assess how the project would affect nature, what the municipalities can do within the legal framework and how municipalities could allocate costs. Results of the projects demonstrated that it is possible to secure the coast with a combination of hard and soft coastal protection without great inconvenience for nature. Consequently, the three involved municipalities chose to continue the cooperation in the fall of 2016.

In addition, it became clear that it is possible to make a 'chapter 1a' case. This means that the project can be financed through a payment model where landowners pay for coastal protection.

In the beginning of 2017, the three municipalities held the first orientation meetings for all citizens in addition to the ongoing engagement with the project's closer stakeholders, such as environmental organizations and coastal teams. The project has a detailed project plan from 2018 onwards, aiming for implementation in 2021.

1.1.2 Scope and objectives

Following the storm floods of the early century and in 1921, the first coastal protection and partly as high tide protection teams and Di-Laws Commission were established after orders of the National Commission. Today there is a number of private coastal protection teams, as well as private landowners which protect the coast in front of their land/ property .

The objective of the project is develop a coordinated large-scale coastal protection with sand nourishment, environmentally and economically feasible, as well as describe any other solutions. The overall plan aims to develop the optimal protection against chronic and acute erosion for 25 and 50 years in the future.

1.2 BwN options and system analysis

1.2.1 System analysis

1.2.1.1 Physical system

Along the North Sea Coast, a large part of the coastline has significantly retreated/ eroded over the years due to chronic and acute erosion, with the exception of the coast west of ports of Gilleleje, Hornbæk and Helsingør. This trend is expected to continue in the future with increasing sea level rise.

1.2.1.2 Societal system

Although there are no specific studies regarding the societal system, various studies within the Nordkystens Fremtid project address part of the social system :

- A land analysis: on land tenure in the project areas
- An analysis/ overview of four potential payment models
- An analysis of house value in connection with sand nourishment
- Grant allocation and risk assessment
- Financing principles in coastal matters – current and earlier
- Note on contribution allocation for coastal protection (in regards to payments)
- Overview of previous coastal protection costs in different coastal protection teams

1.2.1.3 Governance system

The project requires that the municipalities of Halsnæs, Gribskov and Helsingør cooperate. It also requires that the landowners – primarily responsible for coastal protection in front of their property - participate economically on a voluntary basis.

1.2.2 Possible BwN measures

The project aims for a strategy of coordinated large-scale coastal project. A technical/ physical analysis on the coastal protection on the north coast has concluded that the extensive loss of sand and gravel on the North Coast cannot be remedied with hard coastal protection and that sand nourishment (sand/gravel) is required to provide long-term and adequate protection of the North Coast.

1.2.3 Possible projects with functional relations

Other projects in the area which might have an impact or relation to the project include 1) Dredging and bypass from the local ports and 2) Landowners private (local) coastal protection projects.

1.3 Design, evaluation and selection

The confidence in the effectiveness of nourishment and nature considerations is the background for the gradually change from hard structures to nourishment. By combining hard

coastal protection with sand nourishment the coastal protection measures is hopefully gradually changed from total hard structures to nourishment. The reason for the change towards a more nature-based approach has mainly been nature considerations.

To evaluate the expected impact of the measures, an environmental impact assessment (EIA) has been executed, providing valuable information about the environmental impact of the measures on the North Coast.

1.4 Setting up the business case

1.4.1 Stakeholder identification and involvement

The main stakeholders are the land owners along the coast and in the adjacent areas, as well as the three municipalities of the project area. There have been two general stakeholder meetings, and various meetings between the three municipalities – organized in a political and a technical group. Analysis and technical design work is carried out by consultants. The project is continuously updating the general public via news reports and releases.

Stakeholder support is very important as their payments are conditional to the financing of the project. This poses a challenge, as in general stakeholders do not want to pay for sand nourishment over hard coastal protection. Also, not all stakeholders want a public beach in front of their property.

1.4.2 Design and decision making process

Planning of the coastal protection is carried out by the three municipalities Halsnæs, Gribskov and Helsingør. However,

The hard coastal protection construction is as a starting point private while the sand nourishment will be a joint agreement between the three municipalities. The execution of sand nourishment will be offered to the market according to prevailing procurement rules.

Currently there is no follow-up planned of the project after implementation, but it is expected that maintenance of the nourishment will be carried out.

1.4.3 Financing

The coastal protection project at the north Zeeland coast will be financed by the municipalities and the local landowners. In a first stage a pilot project in Gribskov Municipality will be carried out as example for similar projects along the entire North coast. This will include price estimates for the proposed solutions that form input for the further work on the payment model which consists of local landowners contributing to the project.

1.5 Upscaling potential

If upscaling is considered to the inner Danish coasts the biggest challenge is the scaling of the wave climate. There is a decisive difference between the wave climate at the north coast, the North Sea coast and the inner Danish waters coast. Furthermore, the institutional arrangements around coastal management in Denmark complicate upscaling: only a part of the coast is managed by the national public authority. In the majority of the coastline local landowners are

responsible for protection of their part of the coast. Local municipalities play a role in coordinating and licensing. In this context, BwN – which typically requires a shared investment in a longer section of the coast – requires cooperation and systems understanding of the long-term and wider-scale benefits, whereas most landowners seem mostly interested in low-cost, short-term options without too much complexity and cooperation.

1.6 In the spotlight/ key lessons learned

- A storm event is a good opportunity to start the conversation about an integrated coastal zone management plan. 'Never waste a good disaster.'
- Use drawings, photo's and descriptive texts to explain the current physical state of the coastline and the issues so that people recognize it and understand the key issues.
- Consider a wide range of solutions and be clear about their pro's and con's. In this case, sandy strategies were added to the 'catalogue' of coastal protection measures to include the whole range of solutions.
- After setting out a general coastal strategy (in this case to reduce sand deficit with sand nourishment) find the best fit for each coastal stretch, taking into account the local conditions, functions and wishes for the future. All the local measures together should strengthen each other and not counteract each other's effects.

2 Netherlands – Domburg

2.1 Introduction

2.1.1 Project description

The Beach Nourishment project in Domburg is located in the Province of Zeeland in the Netherlands. The project was executed at 2008 by the national infrastructure agency, Rijkswaterstaat. The project was finished in 2008 and a new beach nourishment is upcoming. The process included planning, getting permits and approvals and preparation by the contractor.

2.1.2 Scope and objectives

During the yearly assessment of the Dutch Basic coastline (BKL, a reference coastline position) it became clear that at Domburg the required state/position of the coastline in the future wouldn't be met anymore. The BKL preserves coastal functions (at the Domburg location primarily safety from flooding and recreation). The objective of the beach nourishment project is to restore or maintain the BKL position for 4-5 years. The scope explicitly does not include a goal to restore a certain beach width.

The scope of the project is determined by the coastal stretch in which the BKL will be exceeded. The scope is determined somewhat wider that the exceedance stretch.

2.2 BWN options and system analysis

2.2.1 System analysis

2.2.1.1 Physical system analysis

The physical system at the project location is well-known: there is a lot of knowledge available on long term sediment budgets due to the forcing waves, tides and storm surges and their impact on the coastal state. This knowledge base is a key part of the evidence base for the expected behavior/ effectiveness of the planned beach nourishments.

2.2.1.2 Societal system analysis

The beach/coast at and near Domburg is important for the local economy/ society due to its high recreation value. This value is addressed in the project design: nourishment is executed somewhat higher in the profile than usual. There are no specific nature preservation

goals/habitat development goals for this project. However, without this (and other) beach nourishment, sediment budgets in the (wider) coastal area will become negative, resulting in the long-term loss of beach and dune habitats.

2.2.1.3 Governance system

Maintaining the coastline position with respect to flood risk management policy is fixed in Dutch legislation. The BKL is the designated benchmarking tool. The National Ministry of Infrastructure and Water management is responsible. Local governments and other parties are stakeholders in this context: they do not have to give permits for the works needed, or contribute financially. At every nourishment a stakeholder consultation is held to inform stakeholders and discuss proposed adjustments on the design.

2.2.2 BwN options

Along the entire coastline, the national coastal strategy entails adding sediments to the coastline to make sure the coastline is kept at the current level – i.e. growing with sea level rise. In the Domburg project there were two BwN alternatives: shoreface nourishment and beach nourishment.

2.3 Design, evaluation and selection

Based on a technical assessment, a beach nourishment strategy was selected for the project as shoreface nourishment was expected to be ineffective – i.e. not result in maintaining the coastline at the required position (BKL). Based on expert judgement, no alternatives at this specific location were assessed.

Adjacent projects planned in the area during the design of the Domburg project include the i) Reinforcement of the Westkapelse sea dike in 2009 which included a seaward extension of the beach and foreshore in front of the dike and ii) there was a wish from local stakeholders to allow for a more dynamic dune management regime to the east of Domburg. Although these projects influence each other positively, these effects were not quanitified up-front and included in the project design.

After implementation the structural coastal erosion has been stopped and the dunal area now meets the flood safety standards because of the sequential beach nourishments.

2.4 Setting up the business case

2.4.1 Stakeholder identification and involvemenet

The national nourishment scheme (of which the Domburg nourishment is part) is updated yearly. Part of this update a stakeholder consultation which is organized yearly: through intensive contacts through regional managers, stakeholders are well known and involved. In the yearly event, stakeholders can express needs and wishes. In addition, prior to the execution of a nourishment, a meeting is organised in which stakeholders can ask questions about the execution details. External communication includes brochures, leaflets and signs at the location.

2.4.2 Financing

The project, as well as the wider coastal nourishment strategy, is funded by the federal government. On this general policy level all the costs and benefits are taken into account: as this specific beach nourishment is part of this strategy, the costs are not evaluated on this level and are not a key decision factor.

2.4.3 Contracting, building and maintenance

A nearly complete design is being delivered by the client (Rijkswaterstaat) to the contractor. The contractor can then make some adjustments in relation to the executing strategy or additional bathymetric measurements.

2.5 Upscaling potential

- Project based on national policy. It fits the local sediment budgets
- Governance on a national level is the most successive factor in this project.
- Long term funding based on national level policy/law (provides continuity)
- Relatively mild hydrodynamic conditions. But that is no must.

2.6 Lessons Learned

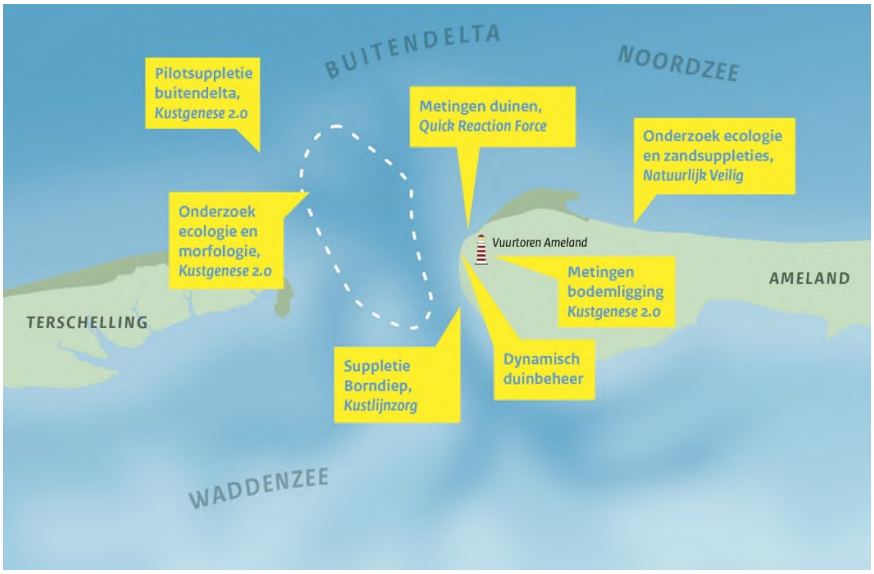
- Results from the regular monitoring (above and under water measurements) are used to design and optimize the nourishments for Domburg.
- As an experiment, a foreshore nourishment was placed a few years ago. Additional monitoring activities makes sure we can measure the effect. We hope it increases the life span of the beach nourishments (now lasting 3.5 to 4.5 years). Nevertheless, it is not our goal to increase the life span as much as possible. Due to the high erosion rates, repeated nourishment will always be neccessary. The eroded sand is not lost but will be transported to neighbouring coastal stretches.
- Based on experience of earlier nourishments it became clear that nourishments should not be placed too high on the beach, that will cause small cliffs on the beach. Also, we know that it is not useful to make the nourishments much bigger, because then it will erode quickly.

3 Netherlands- Amelander zeegat

3.1 Introduction

3.1.1 Project description

The project 'Pilot sand nourishment Amelander zeegat' is a part of the overarching knowledge programme Coastal Genesis 2.0. The pilot is located in the North Sea and entails the deposition of 5 million cubic metres of sand on the seabed in the Ameland inlet.



The pilot sand nourishment is currently underway (March – December 2018).

3.1.2 Scope and project objectives

The Amelander Inlet case is a sand nourishment pilot that is part of Coastal Genesis 2.0, a research and knowledge development programme. The primary objective is to experiment, generate knowledge and create an evidence base for long term coastal management. The pilot itself is therefore currently additional to the overall coastal flood risk management. In addition to the research objectives regarding coastal safety, the pilot sand nourishment is also monitored for its ecological effects. This is usually not within the scope of work of implanting agency Rijkswaterstaat, but was identified as a win-win opportunity to learn more about the ecosystem functioning of tidal inlets. An additional aim of the study is therefore to analyse how marine animal populations recover following the pilot nourishment. Ultimately, the research should provide insight into the most appropriate level and location for such nourishment in order to minimise ecological impact.

3.2 BwN Options and system analysis

3.2.1 System analysis

3.2.1.1 Physical

The physical processes of tidal inlets and outer deltas are still relatively unknown. Many modelling studies have been performed to get insights into the behavior of these areas. However, data for validating and calibrating these models is lacking. The performance of the

models therefore is uncertain. Besides the nourishment pilot, a large scale monitoring campaign measuring large and small scale hydro- and morph dynamics was conducted. The final results are not available yet.

In addition, a sand nourishment on the outer delta is new as well. However, previous experiences with large sand nourishment research projects such as the 'Zandmotor' have provided relevant knowledge that constitutes a large part of the reasoning for the current pilot.

3.2.1.2 Societal

The pilot takes place in the surroundings of the Dutch Wadden Sea close to two islands, Terschelling and Ameland. The inhabitants and stakeholder organizations have been informed about the pilot and involved during stakeholder meetings (including representatives from e.g. fishery, nature conservation). What is different from other BwN projects is that the sand nourishment is not visible at first hand, and also its potential effects will only be visible in the long term (e.g. less beach nourishments). However, the ecological monitoring that is part of this pilot can potentially result in useful spinoff for stakeholders on the islands.

3.2.1.3 Governance

Rijkswaterstaat is part of the Ministry of Infrastructure and Water Management, which is ultimately responsible for coastal flood risk management. In order to expand our knowledge, the Deltaprogramme Coast indicated the need for Coastal Genesis 2.0, which included the need for an outer delta pilot. This provided the rationale and funding to execute a pilot at this location.

Receiving the required permits was identified as a potential barrier to this pilot early in the process: since it is an area that was previously untouched both a building and a nature permit had to be issued. To address this barrier, it was important to establish the right connections at an early stage, because the nature of the research project required some flexibility and more understanding from the agency ILT as opposed to a regular permit process.

This pilot is also seen by Rijkswaterstaat as a way of getting more understanding on possible barriers and constraints for innovative projects as this one, especially about the processes and implementation. Also on the governance side this is regarded as 'learning by doing' and can subsequently be used in order to improve the planning for future projects.

3.2.2 BwN options

It is an explicit goal of Coastal Genesis 2.0 and this pilot to study new alternatives for coastal management and to generate knowledge on these various options. Whereas the usual method would be sand nourishments directly on the beach or shoreface, in this pilot the sediments are deposited on the seabed in the inlet.

The fact that the nourishment is not taking place on the beach but instead on the outer delta significantly decreases the nuisance for most stakeholders.

3.3 Design, evaluation and selection

Key considerations during the design of the pilot where amongst others the location, the practicalities of the execution and future scalability. The current location was chosen based on expert sessions and a formal advice from the expert network water safety (ENW).

3.4 Setting up the business case

3.4.1 Stakeholder identification and involvement

There has not been a formal stakeholder analysis. However the key stakeholders, two municipalities (islands) and the Province of Friesland, were involved from early on. The regional Rijkswaterstaat Noord Nederland office has played a key role in informing and communicating with the various stakeholders (local governance, fisheries, nature conservation, inhabitants, tourism industry etc.).

The inclusion of the ecological monitoring has resulted in some cooperation with partners that are usually not strongly involved with the coastal community, such as the Royal Netherlands Institute of Sea Research (NIOZ).

3.4.2 Financing

The pilot is being financed through the research programme Coastal Genesis 2.0. What this could potentially mean for financial arrangements at the national coastal strategy if this pilot is to be successful and becomes a regular coastal safety measure still has to be seen and is outside of the scope of the current pilot.

3.4.3 Contracting, building and maintenance

Rijkswaterstaat has chosen the regular process of a tender, published on Tenderned. This included a regular design and construct process where the company that could place 5 million cubic metres of sand on the Ameland Inlet seabed for the lowest price received the contract. For the management of the contract regular conditions apply. Additionally, Rijkswaterstaat is in charge of the monitoring of the sand and ecological effects, the main goals of this pilot. This is also a process of learning by doing, how often do you monitor, what do you monitor, etc., these are all lessons to be learned for possible future sand nourishments (incl. monitoring).

3.5 Upscaling potential

RWS is busy gathering the necessary knowledge and evidence base needed for upscaling this kind of measures.

The Coastal Genesis 2.0 programme will provide a first policy advice in 2020, but is scheduled to run until 2028. There is a possibility of a continuation of the pilot, or a second pilot, but these decisions will still have to be made and will depend on the results and achievements, as well as the available budget after 2020.

3.6 In the spotlight/ key lessons learned

- The reason for the project is the current knowledge gap about the natural sediment supply to support the coastal safety of the Wadden Islands. The sediment supply due

to natural dynamics appears to be reducing, but we do not yet understand why. Nourishment in an eb-tidal delta could be a solution but has not been implemented before: an important objective is therefore to increase system knowledge and learn about the feasibility/practicability of implementing a nourishment in an eb-tidal delta.

- The scope for the project was identified based on earlier research. Ameland was chosen as project location because it is a relatively undisturbed eb-tidal delta. In addition, monitoring was already taking place in several research programmes. In total 5 M m3 of sand is nourished. Hypothesises were identified in three categories: general (feasibility), morfology and ecology.

4 Denmark- Lodjbjerg

4.1 Introduction

4.1.1 Project Description

The 110 km long coastal section is located at the central part of the Danish North Sea coast. Here the tidal range is rather small, and the 1:100 year design water level varies between 2.50 m to the north and 3.00 m to the south. The 1:100 years wave height is 8 m.

After a 1:100 years storm in November 1981 it was decided to improve the coastal protection level at the section Lodbjerg-Nymindegab. A common agreement was settled between the government, the county and the local municipalities about financing of the coastal protection measures. In the first part of the period since the start of the common agreement in 1983 focus was on building coastal structures as revetments and low breakwaters. From the beginning of the 1990's sand nourishment played a still bigger role. From starting with mainly beach nourishment shoreface nourishment became more and more important after DCA had participated in the EU-project NOURTEC in the period 1993-96.

4.1.2 Scope and Objectives

The objective of the nourishments over the past decades was to stop coastal retreat, particularly in locations where houses and infrastructure were threatened. The other objective was to maintain a high water safety level of 100 years against inundation of the hinterland. At Thyborøn the safety level was fixed at 1.000 years, because of the risk of isolation of the town in a high water situation.

Since 1983 there have been common agreements about the coastal protection at this section of coast. The agreements were renegotiated every 5 years. The present agreement is for the period 2014-18, so a new agreement has to be settled for the next period. Improved understanding of shoreface nourishment would be an interesting result of the Interreg BwN project.

Monitoring

There is a monitoring programme which consists of annual profile surveys in lines perpendicular to the cost and an annual laser scanning of the dune zone. After three years of the agreement period a midway report is prepared. Here status for the coast is evaluated.

4.2 BwN Options and System analysis

4.2.1 System analysis

4.2.1.1 Physical

The coastal retreat rates at the coastal section are based on analyses of surveyed coastal profiles located with a mutual distance of 600-1.000 m. Analysis of the high water protection level is based on annual laser scanning of the dune zone.

Besides this basic knowledge of the coast there have been completed totally about 20 development projects, where different topics related to this part of the coast have been studied in detail. One of the most important findings is the documentation for the existence of sand waves migrating along the coast.

The environmental impact of nourishment has been analysed in a report about polychaetes. Also a newly started EIA investigation will give valuable information about the environmental impact of the measures carried out between Lodbjerg and Nymindegab.

4.2.1.2 Societal

A socioeconomic analysis for Lodbjerg-Nymindegab was carried out in 2007. The main result was that the coastal protection investment was profitable.

As a supplement to this analysis an analysis was carried out of the number and value of the houses lost or inundated in a 25 years period in case of no coastal protection. About 10.000 houses with a value of 1.5 billion Euro are in this risk zone. It is important to notice that most of these houses will already be damaged in the first 5 years period if nourishment is stopped.

4.2.1.3 Governance

The DCA is responsible for the analyses and the planning of the coastal protection. From a technical point of view the grants available should have been larger in the later agreement periods. Damages to the revetment and too much beach nourishment instead of shoreface nourishment have been the result.

4.2.2 Possible BwN Measures

BwN measures relevant for Lodbjerg-Nymindegab coastal stretch are nourishment, by-pass and sand drift damping. Because the project has been running since 1983 much knowledge has already been generated, but new findings in BwN design are of course of interest.

4.2.3 Possible projects with functional relations

Shoreface nourishment has got increased attention since 1983. At the port entrances at Thorsminde and Hvide Sande a by-pass of sand has been used since 1983. Also fascine placing and marram grass planting have all the years been used in sand drift damping. All three methods are analysed in BwN.

4.3 Design, Evaluation and Selection

Coastal protection measures have gradually changed in the area from hard structures to nourishment. The reason for the change has mainly been nature considerations. The confidence in the effectiveness of nourishment and nature considerations have been the background for the gradually change from structures to nourishment.

The costs and benefits of nourishment have been analysed in the socioeconomic analysis for Lodbjerg-Nymindegab carried out in 2007.

4.4 Setting up the Business Case

4.4.1 Stakeholder identification and involvement

Planning of the coastal protection is carried out by the DCA. If new coastal protection measures were considered it would be naturally to involve stakeholders. An example could be introduction of a sand engine.

The main stakeholders are the house owners along the coast and in the low-lying areas behind the coastline. These stakeholders are represented by the municipalities, and have in earlier phases been invited to information meetings, and a questionnaire survey has been conducted. Here the residents were asked about their feeling of being safe regarding inundation of the hinterland. Because there is very little criticism on the organisation of coastal protection at Lodbjerg-Nymindegab it is not necessary to involve stakeholders more.

4.4.2 Financing and procurement

Finance/ funding

Because the present agreement period 2014-18 soon ends the DCA has been arguing for more money to the nourishment programme in the next period. Because of the large increase of the grant level political acceptance will be necessary.

Procurement

Until the period 2014-18 the agreements with the contractors were only for one year. After a consultant in 2012 had analysed the topic it was decided to send out the nourishment project in tender for a five years period. Also maintenance dredging of a number of waterways was included in the tender.

4.5 Upscaling potential

If upscaling is considered to the inner Danish coasts the biggest challenge is the scaling of the wave climate. There is a decisive difference between the wave climate in The North Sea and in the inner Danish waters.

Additionally, the institutional arrangements around coastal management in Denmark complicate upscaling: only a part of the coast is managed by the national public authority. In the majority of the coastline local landowners are responsible for protection of their part of the coast. Local municipalities play a role in coordinating and licensing. In this context, BwN – which typically requires a shared investment in a longer section of the coast – requires cooperation and systems understanding of the long-term and wider-scale benefits, whereas most landowners seem mostly interested in low-cost, short-term options without too much complexity and cooperation.

4.6 Key lessons learned

- Monitoring shows the effectiveness of common practice measures, and pilots and international projects - knowledge exchange - can be used to test the effectiveness of an alternative (better) solution.

5 Netherlands - Munnikkenland

5.1 Introduction

5.1.1 Project Description

This project includes a dyke relocation and flood risk excavation at the westernmost tip of the province of Gelderland and at the former convergence of the Rivers Waal and Afgedamde Maas.

Planning and preparations for the project started around 2005, building started in 2013 and was finished in 2016.

5.1.2 Scope and Objectives

Overall river management strategy

This project was part of the larger Room for the River programme that started in 2007 and is currently being wrapped up, which included over 30 projects and a budget of €2.3 billion. The main objective of the programme was to increase the protection against floods by creating more room for the river and increasing the maximum discharge capacity. In addition to safety, increasing spatial quality (for people, planet and profit) was the second objective.

Munnikkenland project

As part of the project Munikkenland the Waal dyke has been relocated towards a more inland section, creating more room for the River Waal, the main distributary branch of the Rhine and the busiest corridor for shipping in the Netherlands. The measures at Munikkenland have increased the river's discharge capacity during extremely high water, without raising its water levels. Furthermore, channels have been excavated in the floodplains, improving the discharge capacity even further.

To achieve the second goal of improving the spatial quality, much attention has been given to nature development, recreation and cultural heritage. All of these have been integrated in the layout of the design. Local residents and other stakeholders were involved in this project and some of their ideas have been given a prominent place in the overall design concept.

Monitoring

The main target of lowering the water level during high water (safety) had to be proven and reached by the end of the project. The results on spatial quality have been evaluated and followed by the independent, nationwide Quality team, under presidency of the Rijksadviseur for the landscape and evaluated at the end of the Room for the River programme.

The targets on nature development have been monitored in https://www.ru.nl/fnwi/@1131211/ruimte-rivieren-leidt-biodiversiteit/ but also in the Water Framework programme. The nature development is still going on and dependent on the maintenance.

5.2 BwN Options and System analysis

5.2.1 System analysis

5.2.1.1 Physical system

Munikkenland is where the rivers Waal and Maas/Meuse historically converged. In the early 20th century this branch was closed off, creating the Afgedamde Maas. A large part of the Munikkenland area is at the riverside of the dykes and is flooded during high water, about once a year.

The dyke relocation Munikkenland and the redevelopment Brakelse Benedenwaarden create a new river-bowl area that contributes the flood safety and the nature value of the floodplains

of the river Waal. The total area is approx. 700 ha. The goal of these measures was to lower the water level in the Waal during high water with at least 10 cm. This had been modelled and calculated during the initial scoping phase for Room for the River, providing the evidence base for the proposed BwN measure. In the Planologische kern beslissing (key planning decision) in 2007 the 600 possible measures were reduced to the 39 projects that were eventually decided on and executed.

In the end the measures at Munikkenland have contributed to a decrease of 11,5 centimetres of the water levels of the Waal, leaving a margin for vegetation and sediment to develop.

5.2.1.2 Societal system

Munikkenland is an area in which water, culture and nature have come together for many centuries. The area includes fortresses that are part of the historical Hollandse Waterlinie: the most prominent is Loevestein Castle, a medieval castle that played an important role in Dutch history as the prison from which Hugo de Groot (politician, lawyer and father of the Mare Liberum principle) escaped. The Castel receives around 135.000 visitors per year. Besides this there are many other remnants of medieval cultivation, smaller batteries of the Waterlinie, traces of a former monastery, a castle and a 'Rechthuis' The environmental and cultural historical value of the area were therefore always key considerations during this project.

Before the project took place, the area was mainly used for agricultural practices on highly fertile agricultural land. A large part of the land was farmed by one farmer who also lived in this area, the rest was divided in around 40 smaller parcels that were farmed by other farmers with their farms outside the area.

Due to the interventions intensive farming is no longer possible: it is now classified as an area for nature and recreation. In some parts a collective of farmers maintains the grasslands in an extensive way.

5.2.1.3 Governance system

The overall Room for the River programme was commissioned by the Ministry of Infrastructure and Water (together with the Ministry of Agriculture, Nature and Fishing and the former Ministry of Spatial Planning) and executed by partners such as Rijkswaterstaat, Staatsbosbeheer, provinces, water boards and municipalities. The programme's philosophy was to select projects with support from the region, hence the role of the Water Board Rivierenland as delegated commissioner of the project. In the evaluation of the governance of Room for the River, this philosophy was regarded as an important enabling factor for its success.

Other governance stakeholders included Rijkswaterstaat Ruimte voor de Rivier(overall programme coordination) and Rijkswaterstaat Oost-Nederland (rivermanagement and river maintenance), Province of Gelderland (permit coordination and cultural historical value), Ministry of Nature, Municipality of Zaltbommel (development plan, local roads), Staatsbosbeheer (maintenance of vegetation).

The project experienced a hiccup in terms of governance. The interventions required a change in the spatial development plan which was initially backed up by the Municipality of Zaltbommel. However, a change in local government after the 2011 elections resulted in a heavy debate in the local council leading to the condition that the Agricultural Nature Cooperation De Capreton was to play a role in agricultural nature conservation (65% of the area). While initially only Staatsbosbeheer was considered for this role, the organisations now work together in the management of this area.

5.2.2 Possible BwN Measures

The overall Room for the River programme included a wide variety of measures. This Munikkenland project was selected as part of 39 measures out of around 600 possibilities that were put forward during the scoping period. Information about the Planologische kernbeslissing (PKB) can provide more background on this phase and decision (https://issuu.com/ruimtevoorderivier/docs/pkb_4)

The main BwN alternative was therefore to not do this project and select another one at a different location further up or downstream. More conventional alternatives could be groyne reduction or raising dykes. For more information about the different measures considered in the programme, see https://www.ruimtevoorderivier.nl/kennisbank/

5.3 Design, Evaluation and Selection

Selection

In the case of Munikkenland it was not a decision to either choose a conventional or BwN solution at this location, but within the RvdR programme to choose which projects were going to be executed. More information about this decision can be found in the MER (Environmental Impact Assessment) and PKB documents. A cost-benefit analysis was conducted for the whole RvdR programme by the Netherlands Bureau for Economic Policy Analysis (CPB), which is

publicly available online. The benefits were measured in terms of lowering water levels, increasing nature conservation area (ha), improvement in spatial quality and an increase in recreational opportunities. In this analysis RvdR/BwN projects were also compared to conventional measures.

Project design

From the start the project had the clear goal of lowering the normative water level with at least 10 cm. The project eventually resulted in lowering the water level of the Waal with 11,5 cm during high water.

This was initially based on models and calculations, but after the intervention/implementation works the projects had to show (with the new terrain data as input for the model) that their targets had been met.

Cultural historical: The measures contributed to the value of the historical Loevestein Castle, part of the Hollandse waterlinie. The road to the fort has been elevated, keeping it longer accessible during high water (a few days per year). Furthermore, the moat around the fort has been restored. And several traces of former dwellings are pronounced in the field.

Nature and recreation: the area that was previously used for agriculture is now managed as (agricultural) nature conservation. A part is purely nature, because the conditions are too wet for any kind of agricultural use. The more dry parts in the floodplains are extensively grazed. This area includes various pathways for walking and cycling that show the wide variety of the nature in the area.

De wakkere dijk (multifunctional riverdyke – 'the dyke that is awake'): One of the more remarkable and visible measures in the area is the new dyke. It is designed to be multifunctional: it is first and foremost meant for safety, but built in a way that takes into account other uses. It is wider and higher than strictly necessary, thereby creating viewpoints for recreation, extra space for trees and a cycle path and places for animals to stay safe during high water.

Implications of design for governance

The strength of BwN projects is that they can potentially serve many different goals, interests and stakeholders. While this may strengthen the business case, it is important for the execution of the project to keep a close eye on the scope. In this case, the scope was clear after 2009 and when a decision was made it was 'frozen.' The helped keeping roles, responsibilities and finances clear.

More information can be found in the 'juridisch-bestuurlijke' evaluation of RvdR.

5.4 Setting up the Business Case

5.4.1 Stakeholder identification and involvement

From the start of the project a consultative group was set up that included stakeholders and inhabitants. The area was not densely populated, yet the necessary relocation of a house and in one case expropriation of a farm was (initially) accompanied with resistance. Several other owners of land were involved.

Next to these local stakeholders other stakeholders included Staatsbosbeheer i.s.m. Free Nature en De Capreton (Vereniging voor Agrarisch Natuur- en Landschapsbeheer Bommelerwaard), provincie Gelderland, Gemeente Zaltbommel, Rijkswaterstaat, Stichting Slot Loevestein, Dunea Duin en Water, Hengelsportvereniging De Rietvoorn, Regionaal Bureau voor Toerisme Rivierenland, Stichting Ark, Stichting Behoud Waterlinie Bommelerwaard, Stichting de Vier Heerlijkheden, KPN, Liander BV, Ziggo, Wildbeheereenheid Bommelerwaard, Historische Kring Bommelerwaard.

These can be roughly divided into groups: governance, nature conservation, cultural heritage, tourism, (water sports) recreation and companies providing utility services.

From the start of the project a consultative (stakeholder) group was set up that included stakeholders and inhabitants and had an independent chairman. Stakeholders and their interests had a place around the table during the planning process. Their input was then taken into account by the steering committee of the project. According to chairman Theo Tijssen the consultative group was therefore able to put the interests of the stakeholders on the agenda.

Active, early cooperation with stakeholders was widely regarded as part of the successful delivery of the project.

5.4.2 Financing and procurement

Financing

The project was funced from the general public budget of the Room for the River programma. Rijkswaterstaat does not report on the costs of individual projects within the Room for the River programme, which has a total budget of 2.3 billion. Approx. 98% of the Munikkenland project was financed through this budget, the other 2% by local government.

Procurement

Due to the nature of the project, from the start it was clear that construction and maintenance were not going to be merged together in a single contract. There were simply too many unknowns about maintenance, while thoughts about how to manage areas dedicated to nature conservation are not static either.

Waterschap Rivierenland was the dedicated commissioner responsible for the EU tender for theconstruction phase, resulting in an Engineering & Construct/EMVI approach (EMVI = Most Economically Advantageous Tender (MEAT)). The contracted combination was Van Oord – GMB.

Maintenance is done by Staatsbosbeheer in cooperation with Agricultural Nature Cooperation De Capreton (see 'governance system' for background info)

5.5 Upscaling potential

Room for the River has received a lot of (positive) attention over the past years and the case of Munikkenland is a good example of bringing together different interests and values.

However, the programme has been finished at the end of 2018: regarding BwN measures in river management we now find ourselves in a new situation. Recently, a proposed river widening project (Dijkversterking Tiel-Waardenburg en Rivierverruiming Varik-Heesselt) has not been granted because it didn't solve the whole flood protection goal. The MKBA (Societal CBA) was not convincing enough and there was a lot of opposition against the measure in the area.

We now see a movement towards an even more integral approach, including i.e. economic activities, shipping, sediment maintenance and nature development. From a governance perspective this requires interdepartmental cooperation with other ministries. This is a recent and ongoing process but will certainly play a role in further debates about proposed BwN measures.

5.6 Lessons learned/ in the spotlight

- The potential of BwN to serve many goals is valuable, but can also complicate the project if the scope remains to broad: at some point during project preparation, the scope was fixed which helped keeping roles, responsibilities and finances clear.
- Involving knowledgeable local residents on the emotional bounding of citizens with the landscape greatly improves the quality and acceptance of the plan, especially if also granted a position in the design process.
- Active, early cooperation with stakeholders was widely regarded as part of the successful delivery of the project.
- Depending on the national framework for funding flood risk protection measures, especially smaller elements of integrated projects with a broader scope (such as recreational facilities) may find co-funding from local stakeholders e.g. public entities: in the Netherlands, the 'Room for the River' program funded the (large) parts of such integrated projects that connected directly to flood safety – additional investments in landscape quality, recreation etc. had to attract co-funding.

6 Denmark – North Jutland, Hjoerring Kommune

6.1 Introduction

6.1.1 Project Description

The coastline of North Jutland on the stretches from Nørlev to Løkken incl. Lønstrup is subjected to chronic and acute erosion. Small-scale localized oastal protection is ongoing on the stretch. The project aims to protect a large stretch against erosion using BwN concepts. At present, the project is still in the dialog phase where the coastal authority and the municipality are trying to convince the landowners that a BwN method as sand nourishment is the right way to protect the coast: in this region, land owners are primarily responsible of protecting their property.

6.1.2 Scope and Objectives

Problem description

The chronic erosion is in the order of 2-4 meter per year per meter coast in the wave-dominated active profile from 8-10 meters depth to the slope which varies from 5 to about 25 meters height. The acute erosion can be up to 10-15 meters during storm.On three stretches, houses and other infrastructure are immediately threatened by erosion, and over time some houses and roads have fallen in the sea due to erosion.

Site description

The municipality has two main focus area Løkken and Lønstrup were beach tourisms is very important: the area is famous for the hard wide beach where it is allowed to drive in your car. So in Nr. Lyngby and Nørlev it is important for the municipality to keep the road to the beach safe.

In the area the big holiday resort Skallerup Seaside Resort is located. The access to the sea and the beach is important for the concept of the resort.

Project objectives

The project shall protect a large stretch against erosion. It is important to the municipality and the citizens to keep the beach width. Tourists are important in the area so the Building with Nature concept on the stretch is expected to receive support. The benefit of building with Nature concept like sand nourishment can increase the value of the area in different ways, depending on the site characteristics: In areas with no beach the beach will increase the value of houses, in areas with a beach it will help protect the values derived from this beach.

Monitoring

The monitoring programme consists of profile surveys in lines perpendicular to the cost and an annual laser scanning of the dune zone every two years.

6.2 BwN Options and System analysis

6.2.1 System analysis

6.2.1.1 Physical system

A preliminary study of the coastal stretch from Skallerup to Nørlev was executed to identify local dynamics and to investigate how the stretch naturally develops. The coastal retreat rates at the coastal section are based on analyses of surveyed coastal profiles located with a distance of 1.000 m.

Additionally, an EIA investigation is executed, expected to give valuable information about the environmental impact of the measures will be carried out on the stretch around Lønstrup where the joint agreement is.

6.2.1.2 Societal system

There is no socioeconomic analysis for the stretch in north Jutland.

6.2.1.3 Governance system

The Danish Coastal Authority is responsible for the analyses and planning of the coastal protection of a part of the stretch around Lønstrup. The Danish Coastal Authority and Hjørring municipality have the last 5-6 years worked together to find a holistic solution for the coastal protection on the whole coastal stretch from Nørlev to Løkken. In September 2019 the Danish Coastal Protection law changed: where previously the Coastal Authority was responsible for granting permission for coastal protection, now the municipalities are responsible for giving permission for coastal protection.

6.2.2 Possible BwN Measures

BwN measures relevant for the stretch from Nørlev to Løkken incl. Lønstrup include nourishment and a bypass of clean sand. A hybrid alternative includes a solution where a revetment covered with sand and with sand in front for it is constructed. In some part of the coastal stretch the landowners already have permission for coastal protection. This includes either a permission for sand nourishment or for constructing a revetment covered with sand and with sand nourishment in front.

6.2.3 Possible projects with functional relations

The Danish Coastal Authority and Hjørring Municipality have a joint agreement for a stretch around Lønstrup. Hjørring Municipality has permission to take sand from the south off the Løkken Læmole to the north (bypass). Additionally there are private projects with coastal protection.

6.3 Design, Evaluation and Selection

Coastal protection measures across the Danish coast have gradually changed from hard structures to nourishment. The reason for the change has mainly been nature considerations, as well as confidence in the effectiveness of nourishment for choosing nourishment instead of hard structures. In North Jutland it is important to keep this trend going because there is a tendency of people wanting the hard construction back.

To this end, improved understanding of the challenges in the implementation of a combined coastal protection method would be valuable, as well as better understanding how coastal protection solutions, combining traditionally coastal protection methods and BwN methods can be designed. The main challenge in North Jutland is to convince the stakeholders of the rationale for BwN methods: they shall pay the largest part of the coast protection and therefore must be convinced of the benefits and efficiency/ safety provided by the BwN solution.

6.4 Setting up the Business Case

6.4.1 Stakeholder identification and involvement

The municipality of Hjørring and the Danish Coastal Authority have over the last 5-6 years arranged several meetings with the stakeholder associations along the coast trying to convince them that BwN solution with sand nourishment is the right solution in the area. So far, the mood becomes more and more positive for each meeting.

6.4.2 Financing and procurement

Financing

The state and the municipality pay for the coastal protection in the joint agreement. But on the rest of the stretch it is the landowner themselves who have to pay for their coastal protection. The municipality has offed to double every krone the landowners put in the nourishment project.

Procurement

The stretch around Lønstrup is a part of the joint agreement which the Coastal Authority is responsible for and until the period 2014-18 the agreements with the contractors were only for one year. After a consultant in 2012 had analysed the topic it was decided to send out the nourishment project in tender for a five years period. Also maintenance dredging of a number of waterways was included in the tender.

6.5 Key lessons learned

- If upscaling is considered to the inner Danish coasts the biggest challenge is the scaling of the wave climate. There is a decisive difference between the wave climate in The North Sea and in the inner Danish waters.

7 Sweden – Råån

7.1 Introduction

7.1.1 Project Description

The project entails various nature based solutions in the catchment area of river the Råån: including e.g. restoration of streams, constructed wetlands, two stage ditches and stormwater ponds. This is a long-term organization (since 1991), supported by a budget and staff. New measures and subprojects are still in planning phase.

7.1.2 Scope and Objectives

The aim of the project in the beginning (1991) was to reduce nutrients in the river and to improve biological diversity in the agricultural landscape. After a while the combination of open solutions for stormwater treatment in the city of Helsingborg and other urban areas were combined with the original measures in different projects to get win – win solutions.

Future projects aim to execute new multi-functional measures in the valley of river Råån to 1) rehabilitate the physical processes of the river and thereby improve flood control and 2) to evaluate existing and planned measures regarding flood control and biology to optimize their performance for the future and to create an evidence base.

7.2 BwN Options and System analysis

7.2.1 System analysis

7.2.1.1 Physical

For existing and new to be implemented measures the physical processes resulting from the project is monitored during and after implementation; later on the impact is monitored less extensively as part of the overall monitoring program of the river Råån.

7.2.1.2 Societal

In the beginning of the project land use was studied for the period 1812-1820 in the whole catchment. About 96% of the original wetlands and about 50% of the streams have disappeared since then, mainly due to drainage activities to improve farming but later also due to urban areas. One goal was to reconstruct about 200 ha of constructed wetlands in the catchment – the size of the whole catchment area is about 20 000 ha.

In the present day, historical land management practices continue to pose a challenge for the management of the catchment. For example, long stretches of the river have old drainage companies stating that watercourses should maintain channelized, for the purpose of draining the surrounding floodplain, without consideration to the environment and climate change. In the river valley long stretches are no longer used for as arable land but instead as pasture, and therefore would be suitable to allow flooding more often than current practice. Furthermore, the rail way runs in bottom of the river valley, making natural hydromorfological processes of the river impossible. There are also a number of buildings situated lower than preferred in the

river valley. This is the setting in which the measures proposed and implemented in the project must operate.

7.2.1.3 Governance

In Sweden the responsibility of coastal erosion, climate adaptation and flooding are divided in different national authorities. There are also different responsibilities for each of the topics at different levels. In Sweden the landowners are responsible to protect their own property and no authority or municipality is responsible for protection. The municipalities have a monopoly to plan all activities in their territory.

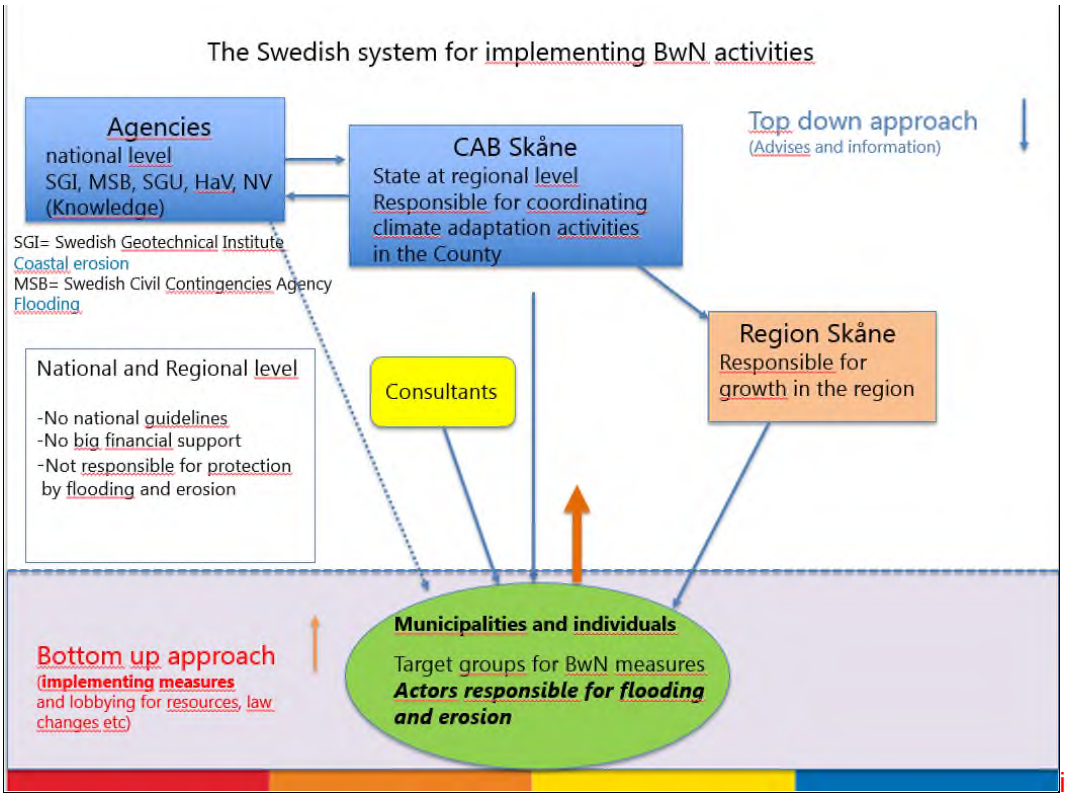
The complexity of the Swedish system means that it is very important to cooperate between public authorities to get a common view of problems and identify measures that will support public interests at different localities. The system promotes local initiatives and engagement.

Some barriers that were identified in the project in relation to governance include:

- The coordination and implementation of water management and mitigating strategies for climate change on a catchment level is lacking. Currently, there is no single actor responsible for such work.
- Most existing waterways and storm water systems are designed only to convey water as fast as possible to the recipient (e.g. the sea), not to slow it down or detain it within the catchment area. Thousands of drainage companies in Skåne county alone have old water permits, stating that watercourses should maintain channelized, without consideration to the environment and climate change.
- Generally, there is insufficient governing of the agriculture and forestry sectors from a catchment management and climate adaptation perspective. Full direct payment from the common agricultural policy (CAP) by EU is paid for unsuitable land use which is quite contra productive as the potential for using floodplains and peaty land to reduce climate impact (i.e. flooding and draughts) is not utilized.

Specific challenges for future NBS projects in the river Raan include the location of the railway; private landowners can oppose the planned measures and stop them; and the existing old permits for drainage companies makes it more difficult and more expansive.

One example of a success story generated from the bottom up approach is how constructed wetlands in the agricultural landscape began with small projects where landowners and municipalities worked together in the beginning of 1990´s. Now the projects have grown bigger and are supported by the Swedish State both financial and by recommendations from several agencies as a good solution in many different topics. The figure below shows how the governance system in Skane works for implementing BwN activities.



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7.2.2 Possible BwN Measures

Preferably measures are taken so that the floodplains of the valley can flood more often than today and the hydromorfology can develop more naturally. This would lead to better flood control for developed areas downstream, as well as improve ecosystem services where the measures are taken.

Physical measures could include re-meandering, local raising of the riverbed and by adding woody debris and other structures. This needs to be done with careful regard of existing infrastructure and buildings. There is also a need of change in land use, mostly from growing crops to grazing in the river valley to allow flooding.

7.3 Design, Evaluation and Selection

It is expected that the identified potential measures contribute to flood risk reduction to a small extent, but they will be multifunctional and contribute to a number of ecosystem services, beside flood control. The evidence on this is not established yet, but will be part of the project. Former projects have showed evidence for improving biological diversity and nutrient retention potential but the potential for flood protection is not so well known in Sweden yet. The monitoring program will contribute to building this evidence base. Key ecosystem services provided by the projects are possibilities for landowners to use water for irrigation, retention of nutrients more production of fish, Improved hunting, added recreational values and increased groundwater supply.

In most cases all the benefits are not calculated or identified. In Sweden NBS solutions are financed from many sources and purposes and are very popular and are rarely questioned – an elaborate quantification or demonstration of projects benefits is therefore rarely necessary: grey and concrete solutions are not a very common alternative in Sweden.

Maintenance is harder to finance. Sometimes for example NBS solutions for stormwater is avoided because of fear of future maintenance cost.

7.4 Setting up the Business Case

7.4.1 Stakeholder identification and involvement

The landowners (state, municipality and private) are the main stakeholders in the project area. They are involved through information meetings in small groups. The public and NGO's are also concerned parties and need to be involved. Already in the beginning cooperation with different stakeholders was a key to success and were identified in the early phase.

The process included pitching the idea for a project in individual meetings with different stakeholders is probably a good start. Thereafter, the design is adapted after the response from the stakeholders.

It is important to adapt stakeholder involvement for different stakeholders and always have in mind the importance of what message the stakeholders are interested in. If you focus on what a specific stakeholder would gain through the project, it is easier to inform about other aspects of a project later. If you have to involve different stakeholders with different interests it can be better to involve them together later in the process and focus on each separately in the beginning.

7.4.2 Financing and procurement

Funding

The budget for the project organization is used as a source to be combined with different financial support from the Swedish state and other sources to expand the project. Most projects have been funded by different public contributors and the Municipality of Helsingborg also have an own budget for water conservation. This system is realistic and acceptable. Storm water ponds are financed by fees from individuals, who have to pay for the stormwater services the municipality offers.

For the measures (e.g re-meandering) it is possible to find financing within EU funds, e.g. European Maritime and Fisheries Fund (EMFF) or the common agricultural policy (CAP) .It could also be co-financed by the state or the municipality.

Managing of the nature reserve (for land that is protected as nature reserve) can be financed by the state. Land that is flooded regularly, and thus turned in to wetland, can be compensated by CAP.

Maintenance

Part of the land where measures are planned is protected as nature reserve and owned by the state and municipality. Maintenance will be governed by the revised statutes of the nature reserve.

Privately owned land (and not protected by nature reserve) could be maintained through a contract stating how land should be governed and land owners should be compensated financially. Or the nature reserve could be expanded to involve more private land and thereby also compensated financially. In most cases the landowners just get compensated for the maintenance of their land by agricultural policy (CAP). This means that it is difficult to optimize measures.

When the NBS are implemented, it is difficult to get money for monitoring.

7.5 Key Lessons Learned/ in the spotlight

- The projects' system analysis included an analysis of historic land use change and present day obstacles related to land use
- In the Swedish governance system there is no coordination of water management and mitigation strategies for climate change at the catchment level; at the same time, there are still a number of adverse incentives in place for unstainable land and water use, complicating a broader integrated water management approach at catchment level: 1) historic water permits for drainage companies stating watercourses should be channelized 2) EU level CAP payments to agriculture and forestry sector are contraproductive to shift to sustainable land use from flood risk and climate perspective.
- As land owners have a large mandate in land use and responsibility in flood protection, the design of measures is strongly influenced by land owners.
- In Sweden NBS are popular and up-front investment costs are usually covered successfully by a range of sources. However, in some cases certain types of NBS are avoided for fear and unclarity of future maintenance costs.
- Maintenance of NBS is arranged differently depending on public or private ownership of the land: in the case of privately owned land, a contract stating requirements and corresponding financial compensation.

8 Sylt

8.1 Introduction

8.1.1 Project Description

The project entails shorefaced nourishment at the southern headland of the Island of Sylt (Hörnum) in Germany and adjacent areas of the tidal inlet. A shoreface nourishment was executed in 2017 and 2019; nearby dike reinforcement and beach nourishment is planned for 2021. The project also aims to develop knowledge, which included measuring campaigns along defined transects before and after the nourishments are important together with LIDAR technology.

8.1.2 Scope and Objectives

The main scope is to carry out a shoreface nourishment and study corresponding sediment transport and the influence on habitats (e.g. benthos). This study includes modelling and monitoring. The project's knowledge objective is to re-use the transported sediments for beach nourishments and dike reinforcement at Utersum on the island of Föhr.

8.2 BwN Options and System analysis

8.2.1 System analysis

8.2.1.1 Physical

The physics behind longshore and cross-shore sediment transports in relation to nourishments are well known; sediment transport modelling has been started in 2016. Required quantities for the nourishment are deduced from the modelling. Additionally, the modelling of habitat development/ impact started in 2017.

8.2.1.2 Societal/ governance

The uses of the natural system are determined by the legal status, as described in Natura 2000, FFH and National Park Statute. Project activities have to fit in there and are conducted by state authorities. As such, no additional societal analysis was needed in the course of the project; there are NGOs who evaluate activities in the area, though.

8.2.2 Possible BwN Measures

Possible measures to reduce coastal erosion in the area include shoreface and beach nourishments and dredging. The search for sediment sources inside or outside the system is a point where the scope can always be extended.

8.2.3 Possible projects with functional relations

Nourishment projects in adjacent areas can benefit from transported sediments and from the increased knowledge base.

8.3 Design, Evaluation and Selection

The primary criterion to select this type of nourishment was to increase coastal security for Sylt and Föhr while minimalizing the impact to the natural system, e.g. reduction of fuel emissions during transports because the sediment transport is partly done by nature itself. There are no

additional ecosystem services intended except conservation of natural values. In the end, the creation of synergies (to nearby coastal locations), a low impact to the natural system and the overall costs have been decisive.

Overall, the project followed these steps:

- Plan the project
- Hold workshops to inform the stakeholders, the involved, the public…
- Create a financial plan and verify it
- Plan approval procedure, approval
- Call for tenders
- Monitoring (before)
- Processing the measure
- Controlling, final acceptance
- Monitoring (after)

8.4 Setting up the Business Case

8.4.1 Stakeholder identification and involvement

The State Government of SH, local government, water boards and NGOs are involved. There is also a trust for coastal protection. Stakeholder engagement included a number of workshops used to disseminate information about the project and discuss this with stakeholders.

8.4.2 Financing & procurement

The financial basis is a joint task from Schleswig Holstein, Federal Republic of Germany and the EU. There are state funds dedicated to coastal protection measures. They are a subject of political agreements.

Procurement was done through a regular tendering procedure.

8.5 Upscaling potential

The reduction of impact to the system and reduced maintenance costs are always important for projects in that area and the bypassing technique (shifting natural driven sediment accumulation) can gain more importance in that context.

The project fits into and serves the “Strategy Wadden Sea 2100” guideline of the ministry of Schleswig-Holstein.

8.6 Lessons learned

- Creating synergies, reducing impact to the natural system and overall costs were decisive factors in deciding on the preferred measure.
- Because the physics of longshore and cross-shore sediment transport in the area were well-known in relation to nourishments, this enabled optimization of the design of this solution while minimizing impact to the natural system.

9 Germany – Langeoog

9.1 Introduction

9.1.1 Project Description

The Langeoog project includes a combined foreshore and beach nourishment which was implemented in 2017 -2018, located in the province of Lower Saxony on the East Frisian island of Langeoog. The project is executed by the Niedersachsischer Landesbetrieb fur Wassenwirtschaft, Kusten un Naturschuts (NLWKN), the responsible state agency.

9.1.2 Scope and Objectives

The primary goal of the project is coastal protection. Applying sand nourishment compensates fpr sediments deficits in the dunal area. The objectives of the project are twofold: 1) preserve the functionality of coastal protection dunes, which form a significant part of the legal flood protection system for the island and 2) get more evidence in different nourishment designs.

The project was planned and started in 2016/17. Due to unusual bad weather conditions, the nourishment is continued in 2018. The project is also continuously monitored.

9.2 BwN Options and System analysis

9.2.1 System analysis

9.2.1.1 Physical system

In the area of the East Frisian Islands the physical processes of the sediment transport are well known in general. Longshore sediment transport and its interaction with tidal inlets as well as cross shore transport are main morphological processes. The situation of the dunes, beaches and foreshore on Langeoog are systematically surveyed by NLWKN.

9.2.1.2 Societal system

The island, located in the Wadden Sea National Park of Lower Saxony, represents a significant place for tourism: the island benefits from the high value of natural environment. Hence NLWKN keeps in permanent contact with the relevant local stakeholders and provides targeted discussions and information.

Langeoog is the only East Frisian Islands without hard coastal infrastructure on the seaside of the island, such as groines or revetments. This was also taken into account in planning the BwN project now and in the past.

9.2.1.3 Governance system

The state of Lower Saxony is responsible for the storm surge protection: maintenance of the islands is a public task. The Legal Basis for this is the Lower Saxony Dike Law (NDG). The NLWKN is the responsible state agency.

9.2.2 Possible BwN Measures

Sand nourishment has been successfully applied in the region since several decades. Beach and dune areas are additionally protected by eco-engineering measures like sand traps or

marram grass planting. Dune reinforcements in the backside of the dune were additionally applied in the past. Hence application of BwN measures bases on long-term experience.

9.3 Design, Evaluation and Selection

Dunes and beaches are a natural habitat for birds and other animals. Sand nourishment includes environmentally friendly measures which show significant advantages compared to building massive infrastructural constructions with significant environmental impacts. Morphological side effects of the nourishment are neglectable.

The project focusses on sharing experiences in the detailed design, evaluation and monitoring of various nourishment techniques: based on morphodynamic analysis several options for the design of the nourishment were pre-assessed and evaluated in terms of performance.

9.4 Setting up the Business Case

9.4.1 Stakeholder identification and involvement

The project is planned by NLWKN-experts in coastal engineering, morphodynamics as well as landscape planning and biology. Due to this organizations' long existence and responsibility in this field, there is a structured engagement process: involvement starts at an early planning phase in order to identify boundary conditions, needs and the legal obligations.

9.4.2 Financing

Coastal protection works is a public task and is funded and financed by federal government and the state of Lower Saxony.

9.5 Upscaling potential

In the course of the project, monitoring, analysis techniques and planning options are enhanced and transferred to other relevant areas.

9.6 Key Lessons Learned/ In the spotlight

- Understanding of natural processes in the project area is key, especially in convincing stakeholders. In this context: the more detailed the local knowledge and models, the better: aside from stakeholder involvement, it helps in in optimizing design (in this case, the search for best sediment extraction area).
- Modelling can give valuable input to understanding the system if calibrated and validated by real measurements.
- The system analysis enabled identification of shoreface nourishment as a multi-effect strategy: the shoreface nourishment reduces costs for beach replenishment (tourism & coastal protection) and dike reinforcement (coastal protection).

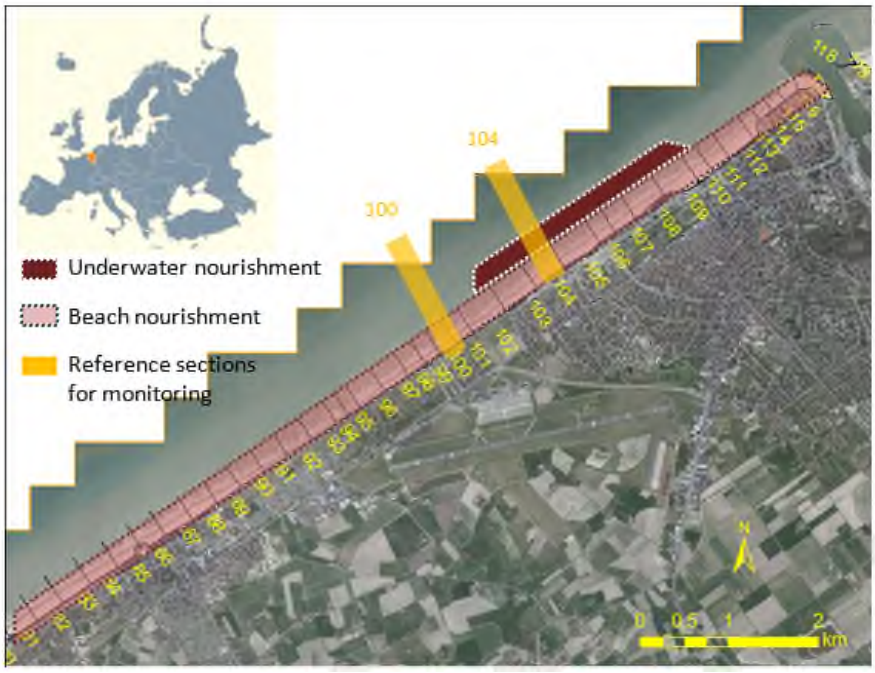
10 Belgium- Oostende – Mariakerke

10.1 Introduction

10.1.1 Project Description

The project entails a shoreface nourishment (indicated as “underwater nourishment” in the picture below), located at the coast of the city of Oostende, in an area which is called “Mariakerke”. Oostende is a city of 71.000 inhabitants located in the centre of the Belgian Coast. The shoreface nourishment and the adjacent nourishments were executed in 2014: intensive monitoring programme after the implementation will last till the summer of 2019. This includes:

- Monthly measurements of the topography
- 2 to 3 times a year bathymetric measurements
- Continuous video monitoring (ARGUS-system)
- Measurement campaigns of currents, sediment, waves, wind



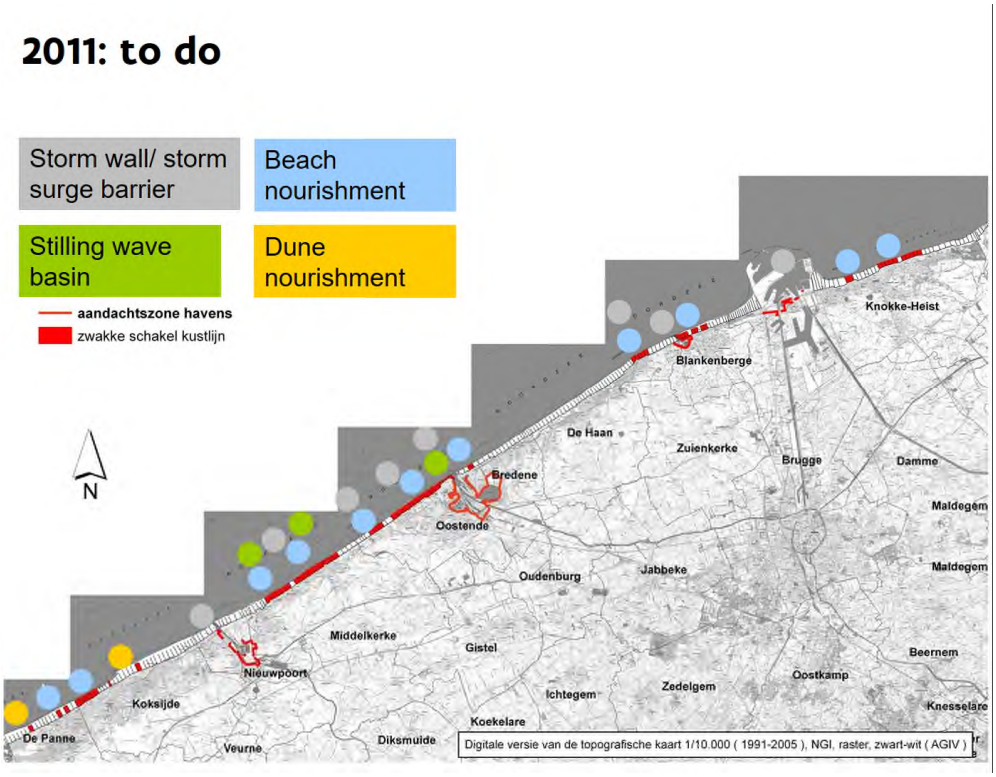
10.1.2 Scope and Objectives

Scope

The Flemish Government has approved in 2011 the Coastal Safety Masterplan which aims to protect the Belgian coast against the impact of a 1/1000 year storm surge event, taking into account sea level rise at least till 2050. MDK – the Coastal Division is responsible for the execution of the Coastal Safety Masterplan, including the execution of periodical safety assessments and the maintenance of the protection measures.

In 2007 a safety assessment was executed in preparation of the Coastal Safety Masterplan and has revealed the “weak links” in the coastal protection system. These weak links can be found

in the figure below: the red sections. They are mainly situated at the sea walls of a part of the coastal towns and in the coastal harbors.



Overall coastal strategy

Based on the results of several studies including risk analyses, cost-benefits calculations, environmental studies and discussions with stakeholders, the most preferable protection measures for every weak link has been chosen. An overview of these measures can be found in the figure above.

One of the most common protection measures at the Belgian coast is beach nourishment. Beach nourishment is a very effective measure to reduce the flood risk and has the flexibility to grow with sea level rise. However, due to the natural dynamics of the coastal system, nourishments require periodical maintenance.

This maintenance is normally done by nourishing the beach where the volume of sand is needed for safety purposes, i.e. at the intertidal and dry beachto reduce overtopping at the seawall by wave breaking). The advantage of this method is that is serves directly the safety standards, however it is more expensive than a shoreface nourishment.

Sand nourishment strategies

In comparison to a traditional beach nourishment, the direct impact of a shore face nourishment on the safety level is smaller because of its location under the water, where wave breaking is less than on the intertidal beach. However this type of nourishments have the potential to serve as an alternative measure for maintaining the beach: by the natural processes

of tides and waves, sand can be transported from this shoreface nourishment towards the intertidal beach, where this sand is needed for safety purposes.

A shoreface nourishment has also the advantage that the execution of the nourishment is less disturbing than a beach nourishment, because no activity will take place on the beach.

Project objectives

The primary objective is to keep the safety level at the required standard. Additionally, at the Belgian coast, little information and knowledge is available about the behavior of shoreface nourishments and its capacity to maintain beaches. Therefore, a pilot shoreface nourishment has been executed in 2014 at the area of Oostende-Mariakerke and is being monitored.

Monitoring results

The ex-post analysis of the performance of the shoreface nourishment is still going on, so final results of the performance of the nourishment aren't available yet. However, earlier intermediate results showed that it will be quite difficult to have clear conclusions about the behavior of the nourishments because of the complexity of the system: occurrence of storm surges, natural sediment transport along the shore.

10.2 BwN Options and System analysis

10.2.1 System analysis

10.2.1.1 Physical

The pilot area, Oostende-Mariakerke, is situated at the Belgian coast, which is characterized by a shallow sandy area.

The coastal layout of this particular area is typical for a Belgian coastal town: a shallow shore face, a quite high and wide nourished beach with groins, a seawall with buildings on top and a city centre next to the sea wall.

10.2.1.2 Societal

The project area has a large touristic value: a large part of the buildings on top of the sea wall are used as holiday rentals, hotels, shops and restaurants. The beach is used for recreation.

10.2.1.3 Governance

MDK – Coastal Division is responsible for the execution of the Coastal Safety Masterplan and maintenance of the coast. The measures of the Coastal Safety Masterplan have been discussed intensively with the local governments (the coastal towns and cities).

10.2.2 Possible BwN Measures

The studies in preparation of the Coastal Safety Masterplan considered different solutions to upgrade the safety level of the weak links. During these studies, the following solutions were considered: 1) only beach nourishment and 2) various combinations of a beach nourishment with adaptations of the adjacent sea wall, groins or the construction of breakwaters. A shoreface nourishment initially wasn't considered as a possible measure due to lack of knowledge about its maintenance capacity for the nourished beach.

10.2.3 Possible projects with functional relations

If this project would be successful as an alternative maintenance method, the maintenance program of the nourished weak links could be changed.

10.3 Design, Evaluation and Selection

The overall potential measures of the Coastal Safety Masterplan (including the project location) were evaluated on costs, benefits and environmental impacts. There were also discussed with the local governments. The cost-benefit studies of the Coastal Safety Masterplan showed that the benefits of the flood defence measures were large compared to the costs. The environmental impact was assessed by a multi criteria analysis of the potential coastal defense measures of every weak link along the coast.

The selection for the shoreface nourishment in Oostende was done on the basis of cost-benefit analysis of different possible measures to upgrade the safety level were considered. The considered costs were: investments and maintenance, also including the influence of sea level rise. The benefits were: the avoided damage due to floodings and the added value of the wider beach.

The selected shoreface nourishment is expected to contribute to the prevention of coastal flooding, due to its potential capacity of maintenance of the beach. Aside from avoided flood risk the benefits include added touristic value of wider beaches. The difference in flood risk benefits between alternative measures were quite small because all measures were designed for the same safety level. The differences in costs were larger.

10.4 Setting up the Business Case

10.4.1 Stakeholder identification and involvement

The impact of a shore face nourishment is quite limited for the users of the beach and local inhabitants. In this light, it was not relevant to have an elaborate stakeholder involvement process with local stakeholders for this project; stakeholder engagement focused on relevant local authorities.

MDK-Coastal Division finances the beach nourishments and the structural elements of the "hard coastal defense measures" (the renovation and adaptation of sea walls, storm surge barriers). Local governments contribute to those hard measures by financing the added architectural and touristic value. This might for example include a more high end finishing of the storm walls, the flooring of the sea walls, furniture on the sea walls. As such, the design and execution of sea wall adaptations and coastal defense works is executed in close cooperation with the local governments.

10.4.2 Financing and procurement

MDK-Afdeling Kust (Flemish Government) has an annual budget for investments and maintenance of the coast and coastal defense infrastructure. Nourishments are financed on this budget.

Procurement

The execution of nourishments is tendered. Most nourishments are tendered separately. Normally, an additional volume of sand is nourished so erosion is compensated for 5 years.

A detailed safety assessment of the entire Belgian coast is done every 6 years. The results of this safety assessment are used for the development of a maintenance schedule of the nourishments. Also intermediate safety checks are executed after significant storm surges and after every winter season. These checks lead to adjustments of the maintenance program.

10.5 Upscaling potential

Upscaling will be possible if the pilot shows that shore face nourishments can be used as an alternative maintenance measure. Decisive factors are: physical behaviour of the shore face nourishment (does it feed the upper beach?), timespan of this behaviour (does it feed the upper beach in a reasonable time?) and costs of the shore face nourishment (in relation to a "classic" beach nourishment).

10.6 Key Lessons Learned/ In the spotlight

- A research pilot programme can be used to assess the effectiveness of an alternative measure for coastal protection, in this case a shoreface nourishment.

Appendix: Quick scan BwN business case template

This template can be used to develop a quick scan business case report for building with nature.

How to use this template:

A number of different text styles have been used within the template, as follows:

- Text in blue is intended to stay in the final document
- Text in normal font provides general guidelines for the section and should be omitted
- Text enclosed in <angle brackets> is intended to be a guide and to be replaced by your own text.

General guidelines for developing a quick scan BwN business case

1. This template for a quick scan business case report for BwN is part of the Building with Nature Interreg project. **The target audience** is therefore the project partners that are case holders of a BwN project.
2. The **objective** of making a quick scan BwN business case report, is to use ready available information to: a) assess the **potential of BwN measures** in a specific location (physical, societal and governance system), 2) identify **stakeholders** that should be involved in the process, 3) identify **financial constructions** to enable the implementation of BwN, and 4) determine potential **limiting or facilitating factors** that could influence the performance of a BwN measure.
3. Carefully select and only include **information** from credible sources and that is directly relevant to and supports your BwN case. Be critical in judging what information to omit and what to leave in!
4. The text boxes contain two sets of questions, the first questions is meant to develop a quick scan Business case, the second question is meant to reflect upon your case and the way the decision and planning process has been conducted. This second question may only be answered when your case has already reached a certain phase.
5. There is additional information and guidance to help you with developing a quick scan BwN business case, notably the High level case description document and the draft guidance document.
6. Please fill in this template for your own case. If you have any questions, feel free to contact Erik van Eekelen (Erik.vanEekelen@ecoshape.nl)

Scope and context

General description of the case

Title

Location <When describing the location, also think of the system boundaries that account for your case>

Scope and project objectives

<Describe the scope of your case. You may define the scope of the project by discussing its primary objective, which in most cases will be flood protection or coastal maintenance. It could also be that your case if foremost a pilot, for experimenting and creating an evidence base. Are there other objectives formally included or that may be considered as well, such as contributing to the implementation of the WFD?>.

<Describe whether the scope of the project was perhaps to narrow and acted as a constraint, so potential BwN alternatives, potential benefits and relevant stakeholder were not identified?>

Status in the design and planning process

<What it the project phase, is it still in the scoping phase, or closer to implementation? Does the include planning and approvals, other preparation, capacity building etc.? Is the project in a stalemate position ?>.

<Describe whether the present state is fixed, or if previous choices are still open to debate and discussion?>

BwN options and system analysis

Physical system analysis

<Please indicate for your case to what extent physical processes are known and what the evidence base is for the proposed BwN alternative.>

Societal system analysis

<Please describe the societal system, and in what way present and potential uses of the natural system are identified and taken into account.>

<Was the initial analysis of present and potential uses complete, and if not would a more complete analysis have influenced the design and decision making process?>.

Governance system

<Please describe the governance system. Indicate possible barriers and constraints related to the governance system, as well as facilitating and enabling factors. >

<Where barriers and constraints identified early in the project, and if not, in what way would an earlier inventory have influenced the design and decision making process?>

Possible BwN measures

<Now you know more about the system, you can identify possible BwN measures. What measures could fit your situation?>

<Did your project identify and consider all possible BwN measures, and if not, would a wider scoping of options have led to new potentially relevant alternatives?>.

Possible projects with functional relations

<Are there projects nearby that may contribute to a BwN alternative, or to which a BwN alternative can contribute? >

<Were these wins -wins considered in the initial scoping and would these have been important to the design and decision making process?>

Design, evaluation and selection

Problem solving performance (physical-technical evidence base)

<To what extent can the identified BwN measures provide the required and desired performance, flood protection and what is the status of the evidence base for this? >

<If this performance is uncertain, was this a consideration in the design and how did it influence the design and decision making process?

Added value ecosystem services (economic evidence base)

<To what extent can the identified BwN measures provide other ecosystem services, and what is the status of the evidence base for this? >

<What are the most important ecosystem services, and did these influence the design and decision making process?>.

Finance (financial construction)

<To what extent are all the costs and benefits of the identified BwN measures taken into account and what is the basis for financing its implementation and maintenance? >

Evaluation and comparison

<Besides costs what other criteria were used in comparing alternatives, such as benefits and what system levels (space, and time) were used? >

<Where additional/other benefits important to the overall costs-benefits of the BwN alternatives and how did this influence the design and decision making process?>

The design and decision making process

<If alternatives have been compared, what was or is decisive in the comparison and final selection? >

<Regarding the preferred alternative, were there conditions formulated that needed to be taken up in the elaboration of the preferred alternative?>

Elaborating the business case

Contracting, building and maintenance

<What form of contract would be best suited for construction and maintenance of the preferred alternative and what are the major arguments in favour of a specific contract form? What were the most important contract conditions and design and implementation requirements?>

<What contract form was chosen and was it adequate? Did this influence the final design and how it was implemented?>

Monitoring, adaptive management and development

<What are the identified monitoring needs, regarding effects, management needs, perhaps use or even financial contributions?>

<What a monitoring plan conceived and implemented. Is it adequate regarding the information needs related to the BwN alternative?>

Financing

<Considering costs, benefits and potential sources for financing, what would be the best financial arrangement? Is this arrangement realistic, acceptable or would it need additional policy making etc.?>

<How was or will the project be financed, and did this have consequences for implementation and maintenance and perhaps also design and decision making?

Setting up the business case

Stakeholder identification and involvement

<Considering the potential effects, ecosystem services, what are relevant stakeholders, and how should these be involved in the project? >

<Was a stakeholder analysis conducted, or how were important stakeholder identified? >

Project organisation and stakeholder involvement

<What would be the best way to involve the different stakeholders (e.g. informing, co-creation, joint-fact finding) and what would this mean for the project organisation and planning >

<How was the project organized and how were different stakeholders involved. Did this work well, or how stakeholder involvement have been improved ?>

Design and decision making process

<Regarding project objectives, potential BwN alternatives, available evidence base and stakeholders, what would be the best way to plan the different steps in the project?>

<How was the planning and decision making process set up, how did it involve stakeholders, how did it address knowledge gaps etc.?>

Upscaling potential

Factors for identifying useful concepts

<Considering the preferred alternative what are decisive factors for it performance and selection (physical, societal, governance) that are also important for its upscaling? >

<Considering BwN alternatives that are not the preferred alternative, do they have potential elsewhere and what are the major conditions that would determine this?>