Ministry of Foreign Affairs

Baseline study West African Case Studies for Coastal Nature Based Solutions

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Baseline study West African Case Studies for Coastal Nature Based Solutions

Inventory, lessons learned and impact study

Client

West Africa Coastal Areas Management Program

Netherlands Enterprise Agency

West Africa Coastal Areas Management Program
& Netherlands Enterprise Agency

Baseline study West African Case Studies for Coastal Nature

Inventory, lessons learned and impact study

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Summary

Coastal erosion and flooding hazards are significant threats to coastal communities, ecosystems, and infrastructure globally. To respond to these global threats, different coastal erosion management approaches and policies have been implemented worldwide. Nature-based Solutions (NBS) are increasingly becoming a standard option for the coastal challenges that the world is facing. Nature-based Solutions are actions to protect, sustainably manage, or restore natural ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits This is also the case in West Africa, where local appetite to better incorporate NBS in the West African coastal region has proven strong through engagement with governments and regional institutions. There is not yet a clear overview of NBS in the West African coastal region. Therefore, this baseline study is performed to explore the stage and make a selection of projects from which results are already visible and lessons learned can be drawn (phase 1, WACA), as well as analyze the social, socio-economic and environmental impacts of NBS (phase 2, RVO).

30 projects with NBS (elements) result from this inventory with a large diversity regarding:

- Project phases: ranging from design, under implementation, to implemented.
- Countries: along the long West African Coast from Mauritania to Nigeria.
- Landscapes: sandy coasts (dunes and beaches), muddy coasts (mangroves), rivers and estuaries, cities and ports.
- Financing: funding from individuals to grants or loans from International Finance Institutes.
- Implementation: from local communities to international contractors.

From this longlist, seven cases were selected to draw lessons learned and four cases to determine their impact. Following an initial selection of projects that have already been implemented and have NBS elements, cases were selected for a range of landscapes, countries, types of NBS, and types of funding. For the cases used to determine impact, there was an additional criterion: the project must include a form of impact assessment.

Lessons learned are drawn from the different NBS projects using the enablers-framework set-up by EcoShape. EcoShape has identified six enablers that address the unique characteristics and increase the uptake and implementation of Nature-based Solutions projects: i) technology and system understanding, ii) multi-stakeholder approach, iii) management, monitoring and maintenance, iv) institutional embedding, v) business case and vi) capacity building. All enablers need to be touched upon in every project and at every phase, also in the pre-feasibility stage. System understanding is required to develop solutions that work in that landscape. Also the involvement of multi-stakeholders is essential to get to a successful project. Monitoring and maintenance is often mentioned as being the most difficult to realize. However, it is also recognized as being important for the adaptability of the solution. To get a sustainable project it is important that the solution is embedded in the institutions at a national and regional level and that there is a viable business case. In terms of acceptance, some stakeholders still have a preference for hard engineering solutions. Younger generations can sometimes be more open to a nature-based approach.

The selected NBS projects clearly show positive impact for society: cultural heritage is protected and there is awareness for positive effects on gender, youth and community health. There is also a

positive socio-economic impact as the projects are often implemented because coastal erosion threatens socio-economic aspects. The implemented NBS made it possible to continue with the existing land use, and in some cases functions are brought back or added. The environment is impacted positively as the projects are restoration projects. Biodiversity is not actively enhanced, the conditions are made such that nature can restore. The projects have limited attention for resource efficiency and pollution prevention. The overarching indicators make clear that stakeholder engagement needs to take place in every project phase to make the projects work. The ownership of the project needs to be with the local stakeholders as well as authorities to make it sustainable in impact and lifetime. Climate resilience as well as Environmental and Social assessment, commitment and management are given limited attention in the projects.

This study shows that when enablers are given attention and are well implemented this enhances impact. The primary recommendation is to act according to the lessons learned with attention for the six enablers. In achieving this, two things are very important:

1. Use a more structured approach. A lot is already being done in terms of NBS in West Africa but every project is discovering their own approach during the implementation of the project. A more structured approach can help to capitalize on this experience and make implementation of NBS more efficient. This is a next step towards upscaling and mainstreaming NBS.
2. Share knowledge and experiences with the West African NBS community. A lot has been learned in all the projects within the themes of the six enablers, which can be valuable in other projects; there is no need to reinvent the wheel.

Acknowledgements

This baseline inventory study for Nature-based Solutions in West Africa would not have been possible without contributions from everyone interviewed. We are very grateful to everyone who made the time to share their personal experience with Nature-based Solutions within the projects that they were involved in, and admire the dedication and pride that were key to making these project a success. For the seven projects that were selected for interviews, a big thank you goes to:

- Pieter Boer (Boskalis) for the Sand motor Togo-Benin
- Patrick Chevalier (senior economist and project initiator) and Thierno Mbaye (IT teacher) for the Wooden groynes in Senegal
- Paul Tendeng (IUCN) for the PAPBIO mangroves project
- Moussa Sall (CSE - Dakar), Victor Lecha (SaVE), Aissatou Sene (CSE), Didier Kabo (AMP) and Liliane Assogba (IUCN) for the Dune restoration project in Saint Louis, Senegal
- Scott Ferguson (flood risk specialist for the World Bank) for The Gambia Integrated Urban and Coastal Resilience Program
- Prof. Mahfoudh Taleb (Directeur Général Institut supérieur des Sciences de la Mer) and Dr. Moine Sidi Mohamed (environmental expert for WACA Mauritania) for the Dune restoration project in Mauritania
- Abnilde de Ceita Lima (responsible for WACA projects in Sao Tomé e Principe) and Arlindo Carvalho (coordinator of the Coastal Resilience Investment Project – WACA ResIP STP) for the Mangroves project in Sao Tomé e Principe

We would also like to thank Sajid Anwar (WB), Vivian Vriends (RVO) and Annelies Kannekens (RVO) for their active involvement in the project, your input and feedback has brought the outcomes to a higher level. Sarah Jung (WB) and Liliane Assogba (IUCN) have also played a valuable role in making the inventory list as complete as possible and sharing their contacts and experience from their work in West Africa.

Finally we would like to thank Jan Udo for the picture on the cover of the report, which was taken during a trip to the coast of Ghana. The protection works on this picture were implemented by the owner of a nearby resort that is threatened by coastal erosion. Unfortunately the defense works were washed away and the beach in front of the resort has now disappeared.

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1 Introduction

Coastal erosion and flooding hazards are significant threats to coastal communities, ecosystems, and infrastructure globally. To respond to this global menace, different coastal erosion management approaches and policies have been implemented worldwide. Even so, the challenges continue to exist despite expensive strategies established to combat these coastal hazards.

There are multiple types of engineering solutions including:

- 'Grey' or hard engineering – coastal management technique used to protect coasts, by absorbing the energy of waves, preventing erosion and flooding;
- Soft engineering – uses ecological principles and works with nature to protect the coast rather than trying to stop natural processes;
- And more specifically Nature-based Solutions – actions to protect, sustainably manage, or restore natural ecosystems, that address societal challenges such as climate change, human health, food and water security, and disaster risk reduction effectively and adaptively, simultaneously providing human well-being and biodiversity benefits[1].

A solution is not necessarily purely grey or purely green, but can also be a combination of both as illustrated in Figure 1.

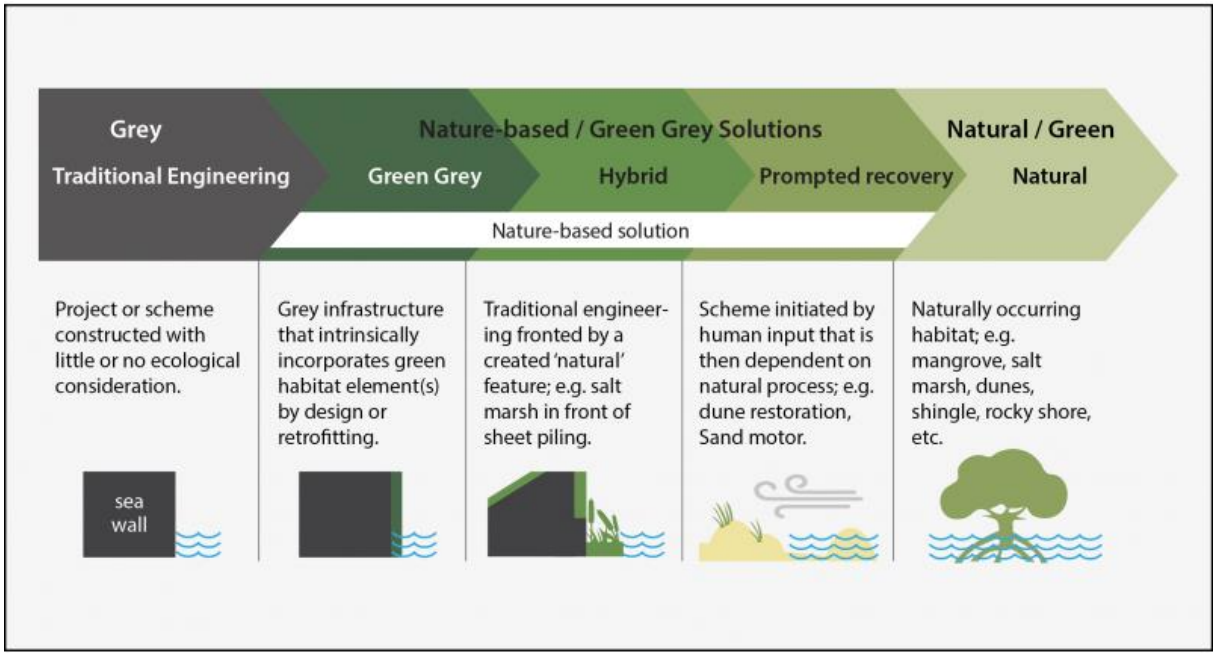


Figure 1 – Engineering solutions can be grey or green or somewhere in between. The spectrum from grey to green is continuous (Source: University of Glasgow, https://oppla.eu/product/19909).

Nature-based Solutions (NBS) are increasingly becoming part of the range of solutions for the coastal challenges that the world is facing. This is also the case in West Africa, where local appetite to better incorporate NBS in the West African coastal region has proven strong through engagement with governments and regional institutions. However, policy- and decision makers in

[1] https://www.worldbank.org/en/news/feature/2022/05/19/what-you-need-to-know-about-nature-based-solutions-to-climate-change

West Africa still primarily resort to traditional, 'grey' engineering solutions due to a lack of understanding and awareness of NBS and its added benefits.

While there is not necessarily a shortage of projects in West Africa that apply NBS, there is not yet a clear overview of what is happening where, and which projects are in a sufficiently advanced stage to determine the lessons-learned, or draw conclusions on the success. It was therefore decided that a baseline study should be performed to explore coastal NBS in West Africa and make a selection of cases from which results are already visible and lessons learned can be drawn (phase 1 study, WACA). The West Africa Coastal Areas Management Program (WACA) is a World Bank program that supports countries' effort to improve the management of their shared coastal resources and reduce the natural and man-made risks affecting coastal communities. The Netherlands Enterprise Agency (RVO) wanted to expand this phase 1 analysis with an impact analysis to showcase the valuable impact of NBS (elements). This can increase the knowledge and awareness of the benefits of integrating NBS into the local coastal protection programs. The report will give an overview of the added value of NBS measures in the projects.

1.1 Project objectives, tasks and outputs

The objective of this project is to show the potential of coastal NBS in all WACA countries for solving problems like flooding and erosion, in combination with nature conservation and restoration and benefits for societal challenges. The inventory study also aims to develop a baseline of knowledge on NBS for coastal resilience in West Africa that can be built upon to advocate for and scale investments in nature-based approaches for local, national, and regional initiatives. This project will also show lessons learned of selected cases on a general scale.

The audience for this project and its deliverables is multiple: i) financers of WACA and other similar programs, ii) decision makers in West Africa, varying from governments to port managers to managers of marine protected areas, iii) researchers, iv) NGO's and v) consultants and engineers.

1.2 Scope of the inventory

This project targets all NBS in the 14 coastal countries of West Africa (Figure 2). This study aims for a comprehensive inventory of coastal Nature-based Solutions projects in West Africa, but understand that it is not possible to identify all NBS. From the projects identified, only seven are assessed through interviews of the project leads.

2 Background

2.1 Project context and literature

The West African coastline covers about 6000 km and includes 14 countries (Figure 2) between Mauritania and Sao Tomé e Principé (Alves et al. 2020). This coastal area constitutes about six deltas, with several rivers and wetlands from Senegal to Nigeria. The coast from Mauritania to south of Guinea (between Sierra Leone and the Niger Delta) is further characterized by linear sand barriers. The central coast of West Africa through the Volta Delta and the Bight of Benin, became infilled between 6000 and 4000 BP with sand (World Bank, 2022) where the major source of sand comes from the Volta Delta in Ghana. Sand from the Volta Delta was always distributed along 300 km of coast (Blivi et al. 2002) in the Gulf of Guinea making the beach quite resilient. The stability of the Bight of Benin as well as the entire West African coast has since then been perturbed mainly by human activities such as the construction of deep-water ports and dams (Anthony et al. 2019) and other engineered solutions.

The coastal area of West Africa hosts significant natural resources as well as habitats that provide critical ecosystem services. In addition, the West Africa coastal area is home to about a third of the population in the region and generates 56% of its Gross Domestic Product (World Bank, 2019). The resources within this coastal environment are critical for the performance of the shoreline, ensuring protection against coastal erosion, contamination, sea level anomalies and severe weather events. At the same time, this coastline is particularly vulnerable because of a mixture of increasing natural hazards, anthropogenic activities and other pressures (Alves et al., 2020). The hazards, which include erosion, are still persistent, and could rise in the coming decades because the changes in climate and human behavior exacerbate them, unless sustainable interventions are realized. The shorelines of West Africa have evolved at a faster and variable rate in recent years. Data related to waves, hydrology, sea level and tidal variation, and the geomorphology show that knowledge on the vulnerability of this coastal area is key to socio-economic development (Appeaning Addo, 2009).

Adaptation investments are needed along the coastline to ensure that vulnerable areas are protected from coastal hazards. In response to coastal hazards, various governments have implemented solutions albeit locally to manage coastal degradation. These include risk reduction through hard and soft engineering, hybrid solutions, nature-based and integrated policy/regulatory solutions. Minimizing the vulnerability of these areas, particularly of human settlements, economic activities and natural resources to the multitude of coastal hazards is vital (Alves et al., 2020).

In West Africa, coastal protection and hazard prevention has become critical due to the rapid increase in coastal hazards like erosion and floods (World Bank. 2022). NBS represent an opportunity to align environmental and resilience goals, at a time of strained budgets in a global context and when short-term needs may run counter to long-term goals.

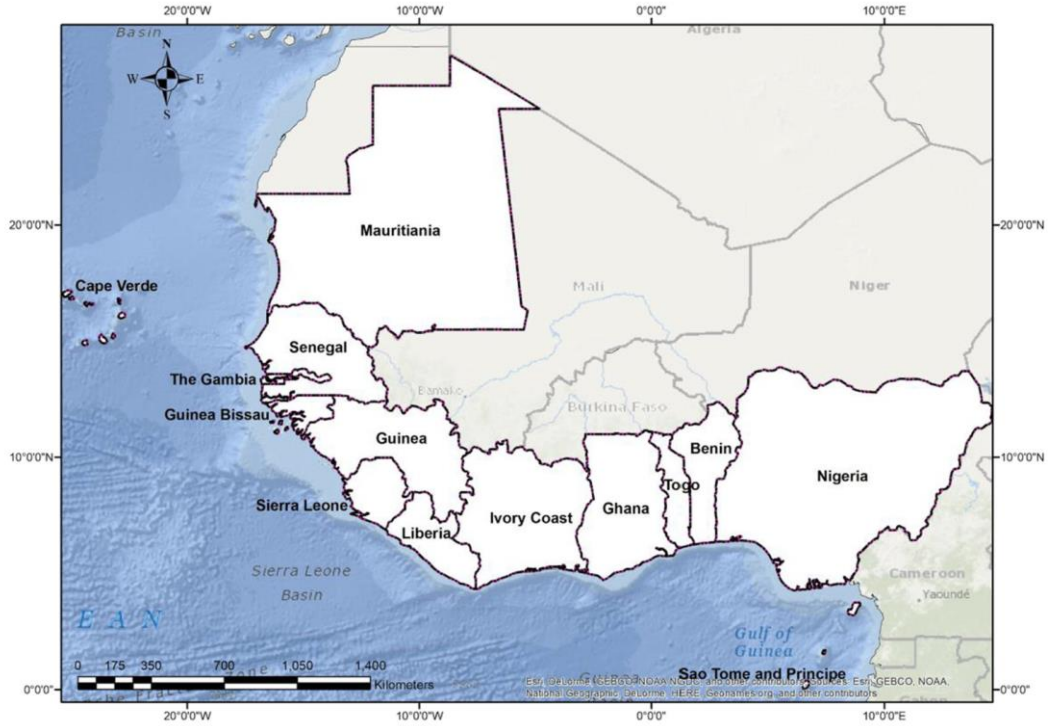


Figure 2 – The West African coastal countries (https://www.wacaprogram.org/countries; Alves et al. 2020)

In Europe, NBS fit the mandates of major EU environmental and climate change policies by restoring biodiversity and enhancing climate-resilience and carbon sequestration. Previous studies have compiled the implementation and lessons of NBS in Europe, for example on the EcoShape website[2]. However, such a study is still lacking in West Africa where, as also found in this study, most NBS projects are still in early stages. The book 'Building with Nature – Creating, implementing and upscaling Nature-based Solutions' that was launched January 25th of 2021, during the Climate Adaptation Summit, shows the diversity of current nature-based approaches and projects around the world. The book contains limited examples from the African continent, even though the WACA program, a coastal protection program in the West African region, has Nature-based Solutions high on its priority list. This is also in part because only a small number of NBS projects have been implemented in West Africa. As the knowledge and experience with NBS for adaptation to natural hazards and climate change increases, it becomes more important to draw lessons learned and insights for replicating and scaling up NBS, especially in coastal areas of West Africa where their implementation is still limited compared to other environments. This study analyses NBS cases across West African coastal and estuarine areas to draw key lessons, understand better the current status of implementation, and identify key challenges and gaps. This study also helps to develop a baseline that can then be used to advocate for additional NBS work in West Africa. Currently, people do not have context-specific information to convince decision makers to consider NBS.

[2] https://www.ecoshape.org/en/

2.2 Terminology

2.2.1 Definition of NBS

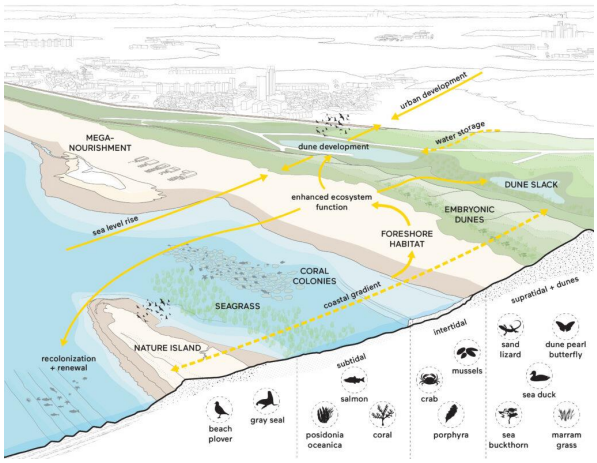
The definition of NBS according to the World Bank is used:

> *Nature-based Solutions are actions to protect, sustainably manage, or restore natural ecosystems, that address societal challenges such as climate change, human health, food and water security, and disaster risk reduction effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.*

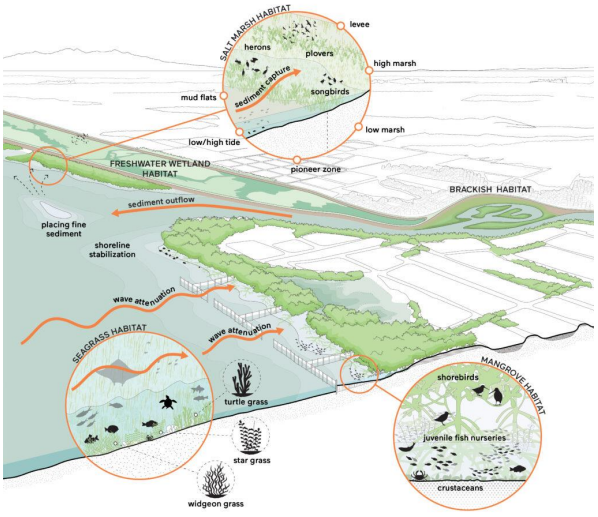
2.2.2 Coast types

The west coast of Africa consists of many different characteristic landscapes (Figure 3). These include urban open shore, urban delta / estuary, urban lagoons, rural open shores, rural delta / estuary and rural lagoons. Only low-lying sandy coasts, muddy coasts, rivers and estuaries, cities and ports are considered in this project based on the landscapes definition by EcoShape:

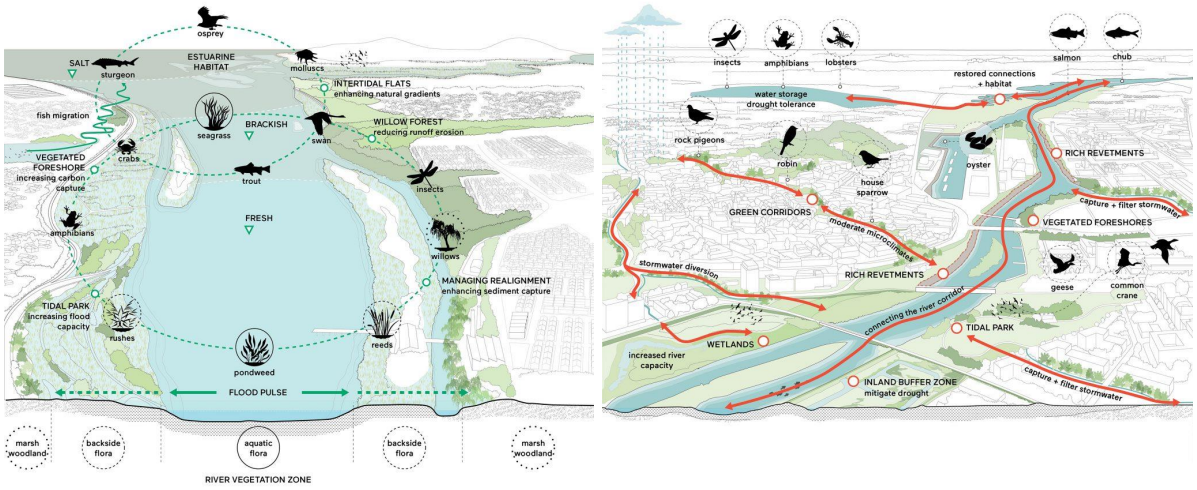
- Sandy coasts, which consist for example of sandy beaches, dunes, sandbars, seagrass and coral reefs.
- Muddy coasts, which consist for example of mangroves, salt marshes, mud flats and seagrass.
- Rivers and estuaries, which consist of fresh, brackish and saline zones with habitats like mangroves, intertidal flats and vegetated foreshores.
- Cities and ports, which consist for example of rich revetments, reefs, wetlands and vegetated foreshores.



Sandy coast



Muddy coast



Rivers and estuaries

Cities and ports

Figure 3 – The four coastal types (EcoShape)[3]: Sandy coasts, Muddy coasts, Rivers and estuaries, Cities and Ports. Full-sized images are included in Appendix C.

2.3 Context with other projects

This assignment will be executed in context of the following projects:

- The WACA ResIP1 regional component supported the recruitment of an NBS specialist by IUCN in Dakar, Liliane Assogba, to mainstream NBS in the Region. She provided valuable input to this assignment.
- The WACA Call4Innovation was launched early 2020 to identify innovative and feasible solutions to address coastal erosion and flooding issues associated with the development of commercial ports with limited planning and consideration of potential impacts to downstream communities. Two of the three winners are part of this project and application of the innovations were kept in mind[4].
- EcoShape is developing guidelines and the World Bank is planning to create guidelines on coastal NBS. Two out of three partners in this project (HKV and Witteveen+Bos) are partners within EcoShape and have contact with the World Bank on how to align coastal NBS guidelines.

[3] https://www.ecoshape.org/en/landscapes/
[4] https://storymaps.arcgis.com/stories/09a08140ebc947168ce9fa3ea63b05f0

3 Methodology

This chapter gives an overview of the methodologies of the following task that are executed:

- Inventory of implemented NBS along West African coasts, resulting in a longlist.
- Selection of valuable West African cases.
- Determination of impact indicators.
- Interviews on selected cases.
- Analysis of cases on lessons learned and impact.

3.1 Inventory of implemented Nature-based Solutions along West African coasts

The purpose of this task is to make an inventory of Nature-based Solutions that are implemented in the West African coastal region in order to raise awareness for the NBS projects already being carried out in West Africa and give a longlist from which projects can selected to draw lessons from.

To get an overview of the NBS in West Africa the Compendium: Coastal Management Practices in West Africa[5] and the Call4Innovation story map[6] was used. Further input was received from WB WACA team (Sarah Jung), IUCN[7] (Liliane Assogba) and the EcoShape-consortium[8]. Also, a stocktaking event was organized to gather information. In the interviews held to get more information about the cases, one of the questions was if the interviewees knew other NBS projects that would be suitable to be integrated in the inventory list as well. With this approach many NBS in West Africa are identified and included in the inventory. Others may exist that were not captured in this preliminary exercise to identify and advance NBS in the region. NBS that may not be included in the inventory are:

- NBS that have started from a bottom-up approach with little to no financing from outside are less visible to the parties involved in the project as well as interviewees;
- Some people are quite strict in their definition of NBS, which is why they don't qualify their project as being NBS even though it might have many NBS elements.

For the inventory, information on the following categories is noted for each project:

- Project name
- Description
- Landscape
- Type of NBS
- Country
- Start
- Project stage/status
- Organizations involved
- Size
- Costs

[5] https://www.wacaprogram.org/knowledge/compendium-coastal-management-practices-west-africa
[6] https://storymaps.arcgis.com/stories/09a08140ebc947168ce9fa3ea63b05f0
[7] https://iucn.org/our-work/nature-based-solutions
[8] https://www.ecoshape.org/en/

- Donor/funder
- Contact person

The complete inventory list was discussed with and added upon by WB (Sarah Jung), IUCN (Liliane Assogba) and RVO (Vivian Vriends) and is included in Appendix A.

The inventory list of NBS is presented in a GIS-layer to demonstrate the distribution of NBS over West Africa and can be found here.

3.2 Selection of valuable West African NBS cases

The purpose of this step is to select a limited number of valuable cases of Nature-based Solutions that are implemented in West Africa. One of the criteria is that the project needs to be at a stage at which outcomes, lessons learned, and impact can be of added value to future NBS projects. For the phase 1 study, which focusses on the lessons learned, seven cases are selected. For the phase 2 study the scope is limited to four cases, so four out of these seven cases are selected for further analysis on impact.

For the selection of cases an assessment framework is used. In this assessment framework the following criteria are set:

- Is the case a NBS according to the World Bank definition (paragraph 2.2.1)?
- Is the case implemented?
  - Only (partly) implemented cases are suitable for the impact study. Some lessons learned could also be drawn from cases that are not implemented yet.
- Is there a contact person we can reach out to?

When the above criteria are met the case is selected as a possible case for interviewing. To narrow down the selection further, cases were compared in order to have a variety of different NBS:

- Different types of NBS: mangroves, sand, dune restauration, etc.
- Different countries: preferably an NBS in at least two different countries.
- Different initiators and donor: to understand different dynamics
- Single project or an umbrella project. Having some umbrella projects in the interviews means something can be learned about several countries while having only one interview.

For the phase 2 impact study, from the projects that are selected for the lessons learned, four projects are selected with impact on society, socio-economics and environment. This required that the projects needed to be implemented.

3.3 Determination of impact indicators

Indicators are selected for the categories social, socio-economic, environmental and overarching. The identification and selection of the indicators is tailor-made for NBS projects in West-African context and presented in Appendix F. The indicators are based on the ecological and social framework (ESF) of the World Bank. This framework is internationally recognized and embraced by governments and other financing institutions and organizations. However, because of the specific characteristics of the West African coast and NBS it is adjusted for the purpose of this inventory. Objective indicators (not influenced by personal opinion) are used as much as possible. The indicators are qualitative and where possible quantitative.

3.4 Interviews on selected cases

Parallel to selecting the cases based on the defined framework, an interview guide was developed (Appendix B2). The interviews were planned with contact persons of the case study projects provided by the projects website, World Bank (Sarah Jung and Sajid Anwar), IUCN (Liliane Assogba), ACECoR (Donatus Angnuureng) and EcoShape (Tom Wilms and Carolien Wegman). The interviewees were provided with a short introduction to the project and the request for an interview of 1,5 to 2 hours minimum in either English, French or Portuguese. The interviews were held with at least two people. One as the interview lead and the other for note taking and time keeping.

For the interviews, a dedicated slide deck was created to guide the interviewees through the different aspects of the interviews. The answers of the interviewees were combined for all interviewers and categorized under 'Project description', 'Enablers – lessons learned' and 'Impact'. The interview notes were send to all interviewees for review.

3.5 Analysis of cases

The analysis is done on the lessons learned (seven projects) and impact indicators (four projects). Both are described below.

3.5.1 Lessons learned

To structure the lessons learned, the interviewees were guided through the Enablers from EcoShape (see Figure 5 and Chapter 5). They were invited to reflect on what went well in the project and what could have gone better and how that could be handled next time. These lessons learned were noted by the different interviewers. In Chapter 5 the lessons learned can be found. For a more complete overview of all information gathered in the interviews please see Appendix B.

3.5.2 Impact indicators

The impact of the selected cases on the categories social, socio-economic, environmental and overarching will be determined based on the indicators stated in the table below. Information on the indicators is collected during the interviews and from documents received. During the interviews the interviewees were guided through the 10 Ecological and Social Standards of the World bank.

The projects will always have impact, but not every project will have information on all indicators, either due to the early stage of implementation or because no evaluation of impacts has been conducted. In addition, impacts can be both positive and negative. Negative impacts can be a result of, for example, the implementation phase such as carbon emissions of construction equipment or lack of stakeholder engagement. In chapter 6 the impacts are analyzed per category and per indicator based on the collected information to showcase the impact of Nature-based Solutions in projects along the West African coast.

Category	Indicators
Social	• gender and youth • indigenous people • community health • cultural heritage
Socio-economic	• livelihood, revenue • multipurpose land use • displacement
Environmental	• biodiversity enhancement • resource efficiency • pollution prevention
Overarching	• climate resilience • sustainability of the solution (monitoring and maintenance) • Environmental and Social assessment, commitment and management • stakeholder engagement

Table 1 – Impact categories and their indicators.

4 Inventory

4.1 Longlist of implemented NBS along West African coasts

Appendix A gives the longlist of 30 NBS along the West African coasts that were found in this study based on a desk study, a stocktaking event and interviews. The geographical distribution of these projects is shown in the webviewer (link to webviewer) and in Figure 4 below. This resulted in a wide range of cases with NBS varying in terms of:

- Project phases: ranging from design, under implementation, to implemented.
- Countries along the West African Coast: from Mauritania to Nigeria.
- Landscapes: sandy coasts, muddy coasts, rivers and estuaries, cities and ports.
- Financing: own funding to International Finance Institutes.
- Implementation: from local communities to international contractors.

From the cases in the inventory, often limited resources were available on the internet. However, in two out of seven interviews it was explicitly mentioned that NBS projects should be able to learn from each other. This is easier when projects share the background and lessons learned of their project online.

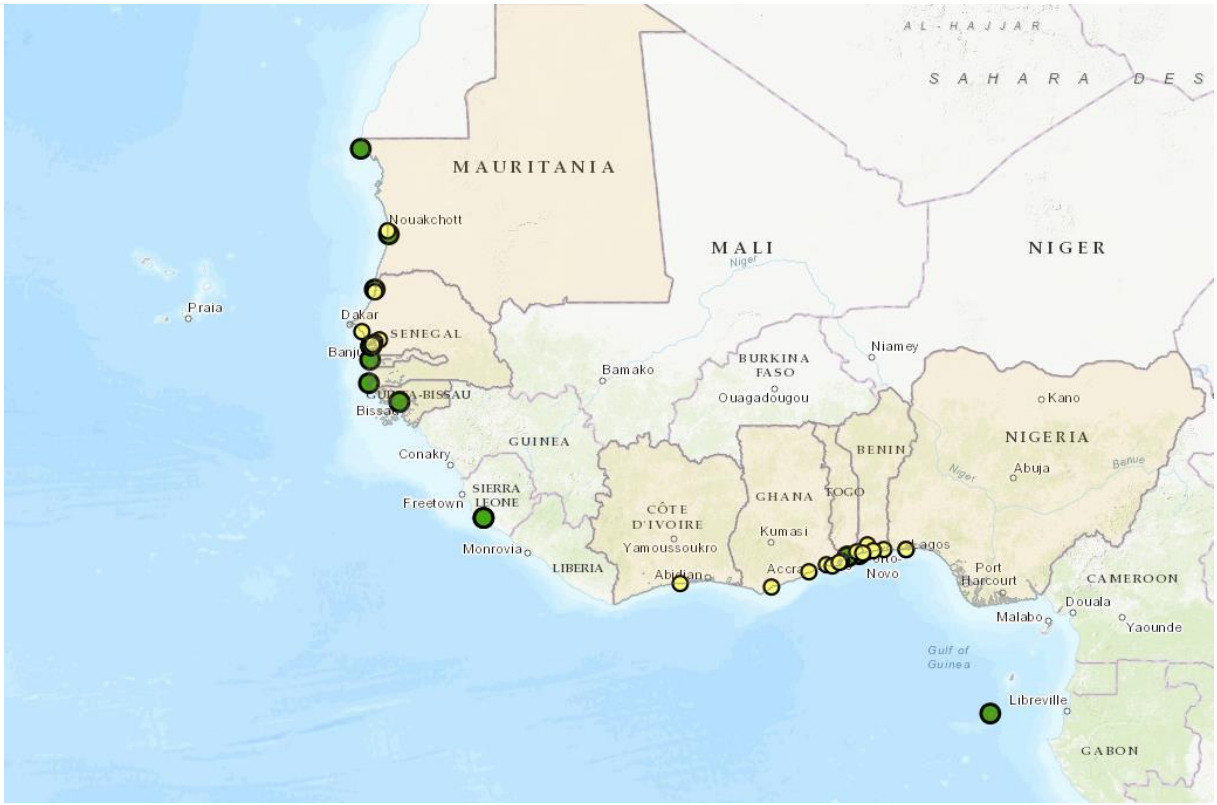


Figure 4 – The 30 NBS projects identified along the West African coastline. Projects that have been included in the interviews are shown in green and other projects in yellow.

4.2 Selection of cases

Phase 1 selection
The cases are selected based on the criteria that are presented in section 3.2 which consist of:

- Is the case a NBS according to the World Bank definition?
- Is the case (partly) implemented?
- Is there a contact person we can reach out to?

Over half of the cases met the above criteria. To narrow down the selection of further the cases are viewed in context with each other to have both a diverse selection as well as similarities to compare regarding:

- Countries.
- Landscapes: sandy beach, river/estuary, muddy beach, urban.
- Implementing organization(s).
- Single project and umbrella projects.

Phase 2 selection:

- Is there information on the impact indicators?

The table below shows the selected cases, seven for the phase 1 study which focusses on the lessons learned and four for the phase 2 study which focusses on impact. More information about the cases is available in the factsheets (Appendix D) as well as in the longlist (Appendix A) and the interview overview (Appendix B).

nr	Name	Implemented	Country	Landscape	Implementing organization(s)	Lessons learned	Impact
1	Sandmotor Togo-Benin	yes	Togo-Benin	Sandy beach	Boskalis	yes	yes
2	Wooden groynes Senegal	yes	Senegal	River / Estuary	Patrick Chevalier / Community	yes	yes
3	PAPBIO Mangroves	yes	Gambia, Guinea, Guinee-Bissau, Liberia, Sierra Leone, Senegal, Togo, Benin, Ghana	Muddy beach	IUCN, United Purpose, Wetlands International Africa	yes	yes
4	Dune restauration Senegal	yes	Senegal	Sandy beach	CSE, SaVE[9], AMP Saint Louis	yes	yes
5	The Gambia Integrated and Urban and Coastal Resilience Program	no, feasibility study finished	Gambia	Urban and Sandy coast	RHDHV	yes	
6	Mangrove Sao Tomé e Principe	yes	Sao Tomé e Principe	Sandy coast	IUCN, multiple local partners	yes	
7	Dune restauration Mauritania	yes	Mauritania	Sandy coast	ACNAV/ISSM	yes	

Table 2 – Selected cases (shown in webviewer).

4.3 General observations

All 30 cases of Nature-based Solutions identified in this study, were different in diverse ways. For some there was no information, the project was yet to be implemented, or poorly implemented and/or any useful records were missing. Most of the NBS approaches were mainly set up for dune rehabilitation, protection of ecosystems and beaches, mangrove reforestation and beach nourishment. Most of the NBS projects identified were implemented between 2000 and 2023. Out of the 14 West Africa Coastal Countries, this study identified Nature-based intervention in 13 countries. In this study Senegal was identified as the country with the highest number of NBS initiatives. Our study did not capture any NBS interventions in Cape Verde. It was noticed that all the coastal projects implemented by governments were funded through grants or loans from financial partners such as the World Bank, FFEM or the EU. The Green Ghana Initiative is an exception. This is a government-funded initiative of the Government of Ghana that largely focuses on global climate change, where trees are planted annually throughout the country. However, because the project is outside the coastal zone, it is not discussed in more detail in this study.

[9] https://www.sablevagueenvironnement.com/

Seven projects were selected from the 30 that were identified for a more detailed understanding. It was noted that the decision to choose for a NBS was based on a number of reasons: they were either the cheapest and easiest to implement at the beach with the help of inhabitants (wooden groynes Senegal), or the natural component of the project was seen as an added value (Sandmotor Togo-Benin, PAPBIO Mangroves project, Dune restauration Senegal). For the Gambia Integrated Urban and Coastal Resilience Program, Nature-based Solutions were experienced as becoming a default option within World Bank projects.

One of the main barriers for most projects was the availability of funds. In the case of the Wooden Groynes project in Senegal, this project could have been expanded if there were sufficient funds. Most of the inhabitants that have to be involved require some form of financial compensation for their time before they can take part in recurring activities such as planting mangroves and plants, building groynes, and carrying out maintenance or a general follow up on the project. It is easier to mobilize inhabitants for a one-time effort. Generally, most projects showed positive results and the potential to improve coastal resilience, if properly implemented.

5 Lessons Learned

5.1 Enablers

Based on the experiences of over a decade of learning-by-doing, intersectoral collaboration, multidisciplinary fundamental and applied research, EcoShape has identified six enablers (Figure 5) that are instrumental to address the unique characteristics of Nature-based Solutions projects. These enablers can aid in the creation, implementation and upscaling of Nature-based Solutions through the Building with Nature approach.

Figure 5 – The EcoShape enablers[10].

In the interviews in this project, these enablers have been explained to the interviewees and their lessons learned categorized under these enablers.

5.1.1 Technology and system knowledge

The technology and system knowledge needed for NBS focusses on the physical characteristics of the larger landscape and the interactions that water, sediment and vegetation have with each other. As indicated in the PAPBIO mangroves project *"it is very important to know your area, each area is different"*. This is why the mangrove reforestation technique that was applied in this project in Senegal, Guinea Bissau and up to Sierra Leone was different from the one applied in Togo, Benin and Ghana. In Senegal, Guinea Bissau and up to Sierra Leone planting seeds works, while in Togo, Benin and Ghana slightly larger plants should be planted to avoid the seeds being eaten by, for

[10] https://www.ecoshape.org/en/enablers/

example, crabs. Rehabilitation of tidal channels can also help to spread seeds. Another example where knowledge of the area plays an important role in the choice for a Nature-based Solution is the Togo-Benin sand engine. Here the dominant current was taken into account. Because there were no groynes yet in downdrift direction, a sand engine located in Benin could spread its influence over a larger area without being hindered by groynes. In the dune restauration project in Mauritania, it was mentioned that local variation in landscape can also be important. The presence of shells, availability of groundwater and exposure to the wind show small-scale variations and strongly influence the chances of survival of the plant used for biological fixation of the dunes.

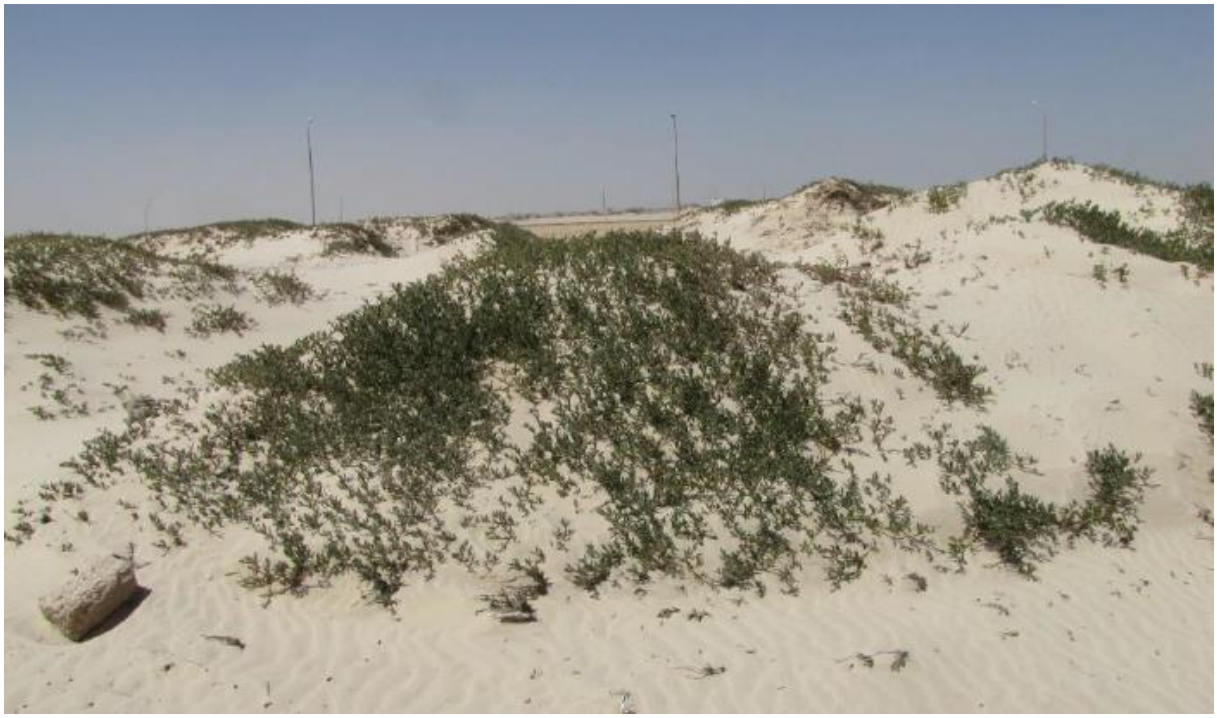


Figure 6 – Sand dunes in Nouadhibou (Mauritania) fixed biologically with the Sesuvium plant[11].

Learning-by-doing was mentioned in the Wooden groynes project in Senegal. In this project and the dune restauration project in Senegal they learned along the way that permeable dams to trap sand by either water or wind work better than impermeable dams. They were able to adjust the design and improve installation techniques based on lessons learned along the way. This shows that understanding the system and being able to do adaptive management is considered as key for successful implementation of NBS. Both projects also used local materials. In Senegal, this included using plant material from the typha plant, an invasive species which has a negative impact on the local ecosystem. By finding a use for the typha plant, which causes eutrophication in freshwater environments, the plant is actively harvested, reducing its population and the associated negative effects on the environment. The dune restauration project in Mauritania took learning-by-doing to the next level with a very scientific approach, carried by the institute of higher education for marine sciences[12]. Extensive experiments were carried out to identify the most suitable plant species for biological fixation of the dunes. Conditions along the Mauritanian coast are harsh and few plants can grow under the saline conditions, with extreme winds and very limited water. Through a series of pilots, survival rates of the Sesuvium plant, which was identified as having the most potential, were improved from 5% to 95% (Figure 6). Insights from these

[11] Photo from : Guide de fixation mécanique et biologique de dunes littorales par des plantes halophiles : cas du Sesuvium (Sesuvium portulacastrum)
[12] Institut supérieur des Sciences de la Mer

experiments include the fact that artificially watering of young plants may be beneficial in the short-term, but that not watering the plants stimulates growth of longer roots making the plant more resilient in the long-term.

Figure 7 – In a number of iterations the design of the wind breakers used for dune restauration in Senegal have been improved. Orientation and permeability of the wind breakers is important[13].

Only the Gambia Integrated Urban and Coastal Resilience Program mentioned using models to understand the system and quantify the effects of a proposed solution prior to implementation. If modelling software was used in the other projects, this was not mentioned in the interviews.

5.1.2 Multi-stakeholder approach

Most projects analyzed via the interviews had strong embedding of stakeholders. The involvement of chiefs and mayors was recognized as important, also over multiple villages if these were all affected, to make sure that all communities are represented. Moreover, in the Wooden groynes Senegal project and the PAPBIO Mangroves project, village children were actively involved. In the Wooden groynes Senegal project they do the monitoring of the project under supervision of their school teachers. As noted in the Wooden groynes project in Senegal *"some children are more capable than adults to understand the workings of the natural system and to appreciate Nature-based Solutions. Children can be the ambassadors for NBS techniques. They see it as logical whereas adults (especially men) sometimes have an image of protection works that consist of grey-infrastructure which they find difficult to let go"*. In all projects inhabitants did (part of) the implementation works (Figure 8). This stimulates ownership and helps to embed the solution in the local community. In the Sand motor Togo-Benin project the wishes of the inhabitants were considered and respected by continuously providing them access to the beach on short walking distance from the village to sustain their livelihood from fishing during the execution of the project.

[13] Photo from : Synthèse de la mise en oeuvre des solutions douces de protection côtière et résultats du suivi dans l'AMP de Saint-Louis : mars 2019-décembre 2020

Figure 8 – Building the wooden groynes in Senegal was a community effort with 100 men, women and children from the village of Diogué involved (photo: Patrick Chevalier). The day was concluded with festivities and a speech from the mayor.

In most projects, stakeholder involvement was an integral part of the project from the start. However, for the Dune restauration project in Mauritania, the initial focus was on the technical implementation. Only in the second phase of the project, an NGO was involved to raise awareness with the local communities. Dunes were seen as a menace due to windblown sand, rather than as protection against the sea. It was important that visitors understand that travelling by 4x4 can make the breaches in the dune cordon more vulnerable and that trampling by people or cattle will prevent the biological fixation of the dunes from being a success.

5.1.3 Management, monitoring and maintenance

Across the projects, there is relatively little (financial) reservation for monitoring and maintenance even though this is recognized as being of high importance by the interviewees. In Senegal, where wooden groynes are used, it is a major issue, as it is very difficult to mobilize people to maintain the groynes, because this takes time that they could also spend generating income. Also, as mentioned in the Dune restoration project in Senegal,: *"the implementation and learning can go in parallel when adaptive maintenance is considered"*.

Of the six projects that have been implemented, five carry out regular monitoring and maintenance following the implementation of the project. Monitoring is mainly used to show that the solutions are technically successful, by showing that beaches are widening, dunes are growing or the mangrove population is increasing. For the dune restoration projects in Senegal and Mauritania this also includes ecological monitoring. There is also a strong focus on learning from monitoring results to improve techniques. For example, the design of the wind breakers the design of the wooden groynes used in Senegal were improved in several iterations. The same is true for the planting techniques used for dune restauration in Mauritania. Of the five projects that do monitoring, four

projects also carry out maintenance, but the interviewees did not explicitly link this to their monitoring programs.

Monitoring is arranged in different ways in the different projects: community-based, as part of research and education, or carried out by a professional organisation. For the dune restoration and wooden groynes projects in Senegal there is monitoring plan with measurements done at regular intervals. In the dune restoration project in Senegal, it helps that the area is a national park. This means monitoring of biodiversity is required by regulations. Results such as bird counts are reported to the ministry. In this project the monitoring is well arranged and carried out monthly by the Marine Protected Area (MPA) of Saint Louis, although it was unclear from the interview for how long and how it is arranged financially. For some projects, monitoring is embedded in education. In the wooden groynes project in Senegal, monitoring is part of the curriculum of the local children and supervised by their teacher (Figure 9). Monitoring results are shared on a website[14] and discussed on an informal basis with the project lead. The dune restoration project in Mauritania is monitored by Master students from the ISSM (institute of marine science). In the PAPBIO mangrove project, communities and NGOs collaborate to conduct monitoring while for the Togo-Benin sand motor monitoring is the responsibility of the government. The monitoring of the sand motor has not yet been initiated, even though the sand motor was completed in June 2023. For both the dune restauration and the wooden groynes projects, morphological development is quantified with sand heights and coastline positions collected at regular intervals. A lot of other monitoring is qualitative, based on images for example. In the mangroves project in Sao Tomé e Principe, this is done through citizen science, with local inhabitants submitting observations of the mangroves. Results are documented and used to demonstrate the effectiveness of the project. In the Coastal Resilience Program in Gambia, it was mentioned that is was difficult to import and install measuring equipment due to length approval procedures at national government level.

Figure 9 – Monitoring of sand height for the wooden groynes project in Senegal is done by school children as part of their education (screenshot from video by Patrick Chevalier[15]).

[14] https://iles-casamance.org/
[15] https://vimeo.com/773116946?share=copy

In the NBS projects assessed maintenance is often community-based. For successful community-based maintenance, early involvement of the community is key. In the PAPBIO Mangroves project, the community does the maintenance afterwards. The community was involved from the beginning alongside the state authorities. In some communities, maintenance is done voluntarily because people understand the benefits of the Nature-based Solution, while in other communities there is a maintenance contract with the local authorities. In some countries, the community was involved in selecting the areas to be reforested. In this way, the community feel they own the project. Moreover, it is necessary that the community understands the advantages of resources (honey, fish, fuelwood, etc) facilitated by the mangroves (capacity building).

A number of projects experience maintenance as being difficult for financial or logistical reasons. For the dune restauration project in Mauritania, maintenance of the fences used for mechanical dune fixation, which are made of wooden posts and palm branches, is done less frequently than required. This is due to the costs and logistical difficulties. In the wooden groynes project in Senegal, it is difficult to mobilize inhabitants because they prefer to spend their time on activities that generate income, which is logical in a low-income community. A solution would be to arrange financial compensation but this is difficult to realize because the municipality has limited financial resources and is poorly organized. This is made more difficult by the fact that the city hall is not in the village where the project is located.

Overall, generating the financial means and overcoming bureaucracy to arrange the monitoring and maintenance is difficult even though it is recognized as being of crucial importance by all projects. Depending on the monitoring and maintenance approach, the chances of successful monitoring and maintenance greatly improve when stakeholder involvement, capacity building and institutional embedding are well-implemented.

5.1.4 Institutional embedding

The institutional embedding in the projects differs, but in general it is considered as important, but also as time consuming. In some projects the NBS is started with a request from the government (Sand motor Togo-Benin) and project activities are gradually included in the national budget (Dune restoration Senegal). When many institutions are involved from the start of the project, programs have an easier institutional embedding process than the ones that start bottom-up. For example, at the Wooden groynes Senegal project which was started by a local initiative, it is mentioned that sometimes larger projects started by the government interfered with this smaller project. In general, it is mentioned that support from the WACA project (World Bank financed) could help in smoothening the bureaucratic process.

Although the bureaucratic process is often described as lengthy, they were not experienced as being a problem for NBS in particular. This is positive because in many countries outside West Africa, design standards make it difficult to choose a Nature-based Solution instead of a grey solution.

With some of the projects being executed in protected nature reserves, it is important to meet and discuss with the conservators. In the interview of the Gambia Integrated Urban and Coastal Resilience Program it was mentioned that younger civil servants are more ‘pro’ NBS than their older colleagues.

5.1.5 Business Case

Most projects are funded by the government, usually via a loan, e.g. the WACA program (Sand motor Togo-Benin, and The Gambia Integrated Urban and Coastal Resilience Program). For the project in Gambia, the initiation of the project is funded by WACA through a grant, while the implementation is funded through a loan. Some projects are also funded through grants: the PAPBIO Mangroves project is funded by the European Union, the dune restoration project in Senegal by the FFEM, and the dune restauration project in Mauritania by WACA. Of the example cases only the Wooden groynes Senegal project is initiated by an individual (Patrick Chevalier) supported by the community. The budget for this project is a lot smaller (initially 100€ for materials and a lot of own time, followed by 4000€ from the French embassy) than the other multimillion dollar projects. In the interview with the Dune restauration project in Senegal it was mentioned that it is highly cost efficient to combine resources of different projects.

Only in the Gambia Integrated Urban and Coastal Resilience project having a business case for reducing of flooding was specifically mentioned. In this case the cost-benefit of protecting the beaches was high, due to the high costs associated with damage from flooding. For the other projects it is not clear if an extensive cost-benefit analysis to select a NBS was executed, although this is requested as part of the technical studies for World Bank-funded operations. The mangrove project in Sao Tomé e Principe is said to have economic benefits in fishing and tourism.

5.1.6 Capacity building

In most projects capacity building was a large component of the project. For example, education in the philosophy of NBS took place for school children in the Wooden groynes Senegal project and the PAPBIO Mangroves project. This improves understanding of the natural processes that form the basis for NBS and raises awareness for how a natural approach can also protect people. Also, in the PAPBIO Mangroves project, specific teaching took place on how to use equipment for monitoring. There was also attention for activities and other linked skills that could help the community improve livelihood (such as how to dry fish without using a lot of energy, how to produce salt without using wood and how to produce honey). The same is true for the Dune restoration Senegal project where agricultural training was provided. In the Gambia Integrated Urban and Coastal Resilience Program there was a one week training on GIS, drone mapping and data management and people were trained to understand models. The Sand motor project in Togo-Benin incorporated local staff in the work and organized a radio broadcast (Radio du Littoral) to raise awareness for their activities.

In some cases, there is also sharing of knowledge between projects. During the Mangrove project in Sao Tomé e Principe, help was received from experts in Senegal on mangrove restoration. The dune restauration project in Mauritania has put a lot of effort in producing a guide which can be used by others who are interested in dune restauration through biological fixation (Figure 10). They have also disseminated this knowledge through a regional WACA workshop.

Figure 10 – Development of biological fixation of dunes in Nouadhibou (Dune restoration project in Mauritania). These images are included in the guide biological fixation of coastal dunes by halophilic plants[16].

5.2 Other observations

Besides lessons learned on the six enablers the following observations were made:

- Projects can learn more from each other. The Wooden groynes Senegal and Dune restauration Senegal and Mauritania projects emphasise that sharing of good practices is important. There could be a role for WACA, because they have a large network and can facilitate dissemination to the West African NBS community.
- Sharing knowledge can be easier in umbrella projects because this is facilitated by the project structure.
- Working with local materials can be less costly and enables the community to do (part of) the maintenance or even support during construction.
- All stakeholders (from government to community) should be involved in all processes, such as choice of location, design, implementation, monitoring and maintenance.
- Involve the community for true commitment after project implementation.
- Projects can also be affected by external issues, like plastic waste. This adds to their initial problems, that need to be solved. For example, in the dune restoration project in Senegal, plastic waste is a problem and may have a negative impact on their ambitions to improve biodiversity.

5.3 Conclusion on lessons learned

Based on the seven interviews the following general conclusions and recommendations are made regarding lessons learned:

- Understand the system and proof positive impact. Have extensive (pre)feasibility studies on the physical and social-economic system of an area in order to find the best possible application of NBS. In some cases a Nature-based Solution may not be the most suitable..
- Flexible design. Ensure flexibility in the design so that adjustments can be made based on insights and observations during the implementation and monitoring phase.
- Monitoring and maintenance budget. Create and ensure a budget (financial and procurement) for long term (multi annual) monitoring and maintenance.
- Use monitoring for adaptive maintenance. The majority of the projects interviewed carry out monitoring and maintenance. The focus of monitoring is on proof of success and knowledge development. By making the use of monitoring outcomes for maintenance explicit, the Nature-based Solutions can be made more adaptive and thereby more climate resilient.

[16] Guide de fixation mécanique et biologique de dunes littorales par des plantes halophiles : cas du Sesuvium (Sesuvium portulacastrum)

- Young ambassadors. Younger people (youth or younger civil servants) are more open to accept NBS than older people. They can act as NBS ambassadors.
- Multidisciplinary team. It is important to involve experts with a technical, ecological, socio-economic and financial background. If a project is, for example, initiated by a purely technical team, other aspects may be overlooked reducing the success and impact of the project.

Despite the small number of projects, the outcomes are quite general and may therefore be relevant and applicable for many NBS projects along the West African coast. The outcomes are similar to what is found in other places around the world.

6 Impact

The impact of the selected cases on the categories social, socio-economic, environmental and overarching is determined based on the indicators stated in the table below. Appendix F presents the identification and selection of the indicators which is tailor-made for NBS projects in West-African context. The impacts are analyzed per category per indicator based on the collected information. Most information is qualitative as it is derived from the interviews and is based on experience and not documented. Some projects have a website and documents are shared. These are mainly descriptive or based on images, and thus also qualitative. For the sandy solutions, the development of the dunes or coastline is quantified but this is not relevant for the indicators included here.

Category	Indicators
Social	• gender and youth • indigenous people • community health • cultural heritage
Socio-economic	• livelihood, revenue • multipurpose land use • displacement
Environmental	• biodiversity enhancement • resource efficiency • pollution prevention
Overarching	• climate resilience • sustainability of the solution (monitoring and maintenance) • environmental and social assessment, commitment and management • stakeholder engagement

Table 3 – Impact categories and their indicators

6.1 Social

For this category the following indicators are used to determine impact:

- Gender and youth
- Indigenous people
- Community health
- Cultural heritage

6.1.1 Gender and youth

In the interviews gender and youth came forward in the dune restoration project (Senegal) where the management of the AMP (marine protected area) is inclusive, both in decisions and implementation. Communities are at the heart of the decision-making process. It was also mentioned that women from Bongo carry out paid work for the dune restoration project.

The wood groynes project (Senegal) is a community effort, where 100 young adults in 8 teams constructed the groynes in a festive setting. Women were also actively involved in the construction of the groynes. Moreover, the goal of the project is to ensure a secure future for young people in a village where livelihoods from artisanal fishing and small-scale agriculture are threatened by erosion. Improved livelihood security will hopefully prevent large-scale migration to cities.

6.1.2 Indigenous people

In this study the terms indigenous people and local community are used. The latter are the people that are currently living in the project areas. For the first, the definition of the World Bank[17] is used: "Indigenous peoples are distinct social and cultural groups that share collective ancestral ties to the lands and natural resources where they live, occupy or from which they have been displaced. The land and natural resources on which they depend are inextricably linked to their identities, cultures, livelihoods, as well as their physical and spiritual well-being. They often subscribe to their customary leaders and organizations for representation that are distinct or separate from those of the mainstream society or culture." Some interviewees have difficulty with 'indigenous people' as it has a negative association.

In the PAPBIO mangrove project and the dune restoration project (Senegal) it was mentioned there are no indigenous populations. In the wood groynes project (Senegal) it came forward that the project allows people to continue with their way of life in rural areas.

6.1.3 Community health

In the projects, the risks for health, safety and security due to the project was limited. For the PAPBIO mangrove project it was identified that surveys with boats can be dangerous, thus training was provided regarding emergencies and safety vests were provided.

6.1.4 Cultural heritage

Various projects protect existing cultural heritage sites. The dune restoration project (Senegal) protects Saint Louis which is a historical town and a UNESCO world heritage site. It also makes sure that culture becomes more sustainable, like the traditional fishing activities. The cultural heritage doesn't change due to the project.

Also the Saloum delta (part of the PAPBIO mangrove project) is a heritage site. The project restores mangroves where they have been in the past. This has resulted in mangrove forest that provides sufficient services for the communities to continue to live at that location and maintain their traditional way-of-life.

In the wood groynes project (Senegal) a new symbol is created. There, coconuts trees are planted on the line that was reached by erosion, symbolizing that the sea will not return.

[17] https://www.worldbank.org/en/topic/indigenouspeoples

6.1.5 Summary

The society is impacted positively by the projects. Cultural heritage is protected by the projects and there is awareness of gender, youth and community health, which can be enhanced with capacity building. The NBS projects often enable inhabitants to sustain their traditional way of life, which is often heavily intertwined and dependent on the natural system. Indigenous people seem not to be present. In general, it seems that when these indicators are mentioned at (the start of) a project, it results in more awareness and positive effects.

It needs to be pointed out that 'indigenous people' has a negative association by some interviewees. It is suggested to the International Finance Institutes to take this into account when using and updating the ecological and social framework (ESF).

6.2 Socio-economic

For this category the following indicators are used to determine impact:

- Livelihood and revenue
- Multipurpose land use
- Displacement

6.2.1 Livelihood and revenue

The projects are often implemented due to (potential) loss of livelihood and revenues, because coastal erosion threatens agriculture and fisheries in the wood groynes project (Senegal) and dune restoration (Senegal). The implementation had as positive effect that the fishermen could continue with artisanal fishing. In the latter project new area became available that could be used for market gardening (maraichage[18]). It resulted in hundreds of people coming back to the area.

6.2.2 Multipurpose land use

The selected cases consist of beach nourishment (Sandmotor Togo Benin), sand trapping (wooden groynes Senegal), dune restoration (Senegal) and mangrove restoration (PAPBIO). All cases had and still have multiple uses of the area, among others coastal protection, recreation, tourism, landing of fishing boats, selling fish and market gardening. These land uses are maintained and at some cases land use was added like tourism and market gardening.

6.2.3 Displacement

In the PAPBIO mangrove project there were no displacements and in the wooden groyne project (Senegal) only land was gained. In the project Sandmotor (Togo-Benin) there was spatial impact on the inhabitants, especially for the groynes as their footprint sometimes intervened with the existing housing. Also the stockpiles and transporting of rock had impact and some relocation needed to take place. For the affected people a plan of action was made for their relocation. It was not clear from the interview how this plan was received.

[18]This is the cultivation of plants for food use (horticulture or agriculture), and more particularly vegetables, in a professional manner, with the aim of making a profit or simply to make a living from it.

6.2.4 Summary

The socio-economic situation is impacted positively by the projects, because coastal erosion threatens houses and livelihood, which are socio-economic aspects. So the purpose of the measures is to protect the area including the existing socio-economic value. The land is often already used for multiple purposes. The NBS made it possible to keep all purposes and at some cases functions are brought back, like market gardening or added, like tourism. At the Sandmotor (Togo-Benin) relocation was needed, and a plan of action was made for that.

6.3 Environmental

For this category the following indicators are used to determine impact:

- Biodiversity enhancement
- Resource efficiency
- Pollution prevention

6.3.1 Biodiversity enhancement

In all cases the effect on the existing environment was minimized and where it occurred it was mitigated with programs, like at the Sand motor (Togo-Benin) eggs of turtle nests were retrieved before the nourishment. At the PAPBIO mangrove project it is expected that the biodiversity will improve due to the restoration, but it is too early to measure changes. Also at the dune restoration (Senegal) the intervention and conservation are stabilizing the dune system and over time vegetation and animals will find the area and colonize it. That ecosystem is still very young and not yet resilient for invasive species which can be a threat for native species that colonize the area.

6.3.2 Resource efficiency and pollution prevention

The efficiency of resources and prevention of pollution had limited attention in the cases. In Senegal's wooden groynes and dune restoration projects, intentional efforts were made to utilize natural materials (wood, sand) to provide coastal protection as opposed to construction materials such as concrete and to switch from plastic construction materials, for example rope to tie elements together, to more natural materials.

6.3.3 Summary

The environment is impacted positively by the projects. Often because the projects are ecosystem restoration projects. Based on observed and current impacts, biodiversity is not (yet) actively enhanced. However, conditions for natural ecosystem restoration are improved. The biodiversity would be enhanced when reforestation is done by planting multiple native species. Thought the attention of the projects to resource efficiency and pollution prevention can be improved, intentional efforts were made to use natural or biodegradable materials.

6.4 Overarching

For this category the following indicators are used to determine impact:

- Climate resilience
- Sustainability of the solution (monitoring and maintenance)
- Environmental and Social assessment, commitment and management
- Stakeholder engagement

6.4.1 Climate resilience

In two of the projects, climate and resilience came forward in the interview. In the PAPBIO mangroves project the goal is a resilient coast by restoring the mangroves. In that project, it is clear that mangroves need time to grow and over time become resilient to more extreme events. The same counts for the dune restoration project (Senegal) where it was stated that the current dune ecosystem is young and not yet resilient to invasive species. In this project SaVE[9] is involved as partner to bring in climate adaptation knowledge. Although not mentioned in the interview the project development objective of the Sand motor (Togo-Benin) is to strengthen the resilience to coastal risks.

6.4.2 Sustainability of the solution (monitoring and maintenance)

Across all projects, sustainability came forward in various ways. A part of the PAPBIO mangroves project focuses on the preservation of mangroves through restoration, while simultaneously building capacity with local communities for sustainable use of resources associated with these mangroves (e.g. honey and fish). The community does the maintenance, because they are involved from the beginning as well as the state authorities. In the dune restoration project (Senegal), project activities are gradually being included in the national budget and in that way longevity is assured as well as through conventions with 15 organizations like universities, NGOs and authorities at various levels. The Sand motor (Togo-Benin) has an expected lifetime of 10 years. After that new measures are required. In the wooden groynes project (Senegal) sustainability is stated as a challenge: how can the local community remain involved to maintain the structures?

6.4.3 Environmental and Social assessment, commitment and management

It is only at the Sand motor (Togo-Benin) where an extensive ESIA was done and the construction work was executed according to the World Bank standards. At the other project sites, no formal assessment was done. At the PAPBIO mangrove project, a diagnose was made of the state of the project locations. At the dune restoration project (Senegal), protocols were made to monitor the profiles. Also, monitoring of aspects like biodiversity was done in the different zones of the national park.

6.4.4 Stakeholder engagement

Across all projects, stakeholders were engaged. At the Sandmotor (Togo-Benin) there was a lot of contact with the mayors and a lot of effort was put in informing and explaining the local communities about the project and its purpose. The wooden groynes (Senegal) were constructed and maintained by the local community and monitoring embedded in the curriculum of the local

youth as part of their education on natural processes and the NBS philosophy. At the PAPBIO mangrove project men, women and traditional chiefs were involved. The purpose of the actions was explained to them together with the expectations to be able to mobilize them. Together the locations were visited to see the state before taking any action. Here the communities are also involved in the maintenance. In the dune restoration project (Senegal), all communities are represented and involved in the decisions and implementation.

6.4.5 Summary

The overarching indicators make it clear that stakeholder engagement is essential to make the projects work. In all project phases, starting with the idea, design, construction as well as monitoring and maintenance the stakeholders need to be involved to make the project successful. The ownership of the project needs to be with local stakeholders as well as authorities to make it sustainable. Environmental and Social assessment, commitment and management were made for the larger projects funded by IFIs. From the interviews came that climate resilience was given limited attention in the projects, however for the Sand motor (Togo-Benin) and the dune restoration project (Senegal) the project development objective is to strengthen the resilience to coastal risks.

6.5 Relation between enablers and impact

The interviews and analysis made clear there are multiple relations between the enablers and impact. In this section a few are described.

- For example regarding the social impact, the interviews show that when stakeholders are engaged and capacity is built, more often children and youth are involved, who can become ambassadors for NBS. Giving attention to these enablers also seems to result in more, as well as active involvement of women in the projects.
- In terms of socio-economic impact, attention for the enablers capacity building, business case and multi-stakeholder approach positively affects livelihood as it is maintained and in some projects diversified. The latter is often the result of multipurpose land use.
- For environmental impact, the enabler monitoring is often mentioned, specifically monitoring the biodiversity, which raises more awareness of biodiversity.
- For the overarching impact, climate resilience is strengthened by the enablers capacity building and system understanding, so the stakeholders know what the future threats and opportunities can be. For the sustainability of the solution there is a strong link with management, monitoring and maintenance, multi-stakeholder approach and institutional embedding. These enablers help to come to a sustainable solution. And stakeholder engagement is strengthened by a multi-stakeholder approach.

This overview shows that when enablers are given attention and are well implemented this improves impact.

6.6 Summary of impact analysis

Based on the four cases that are analyzed, the following summary is made:

- The society is impacted positively by the projects. Cultural heritage is protected by the projects and there is awareness of gender, youth and community health. In general, mentioning these indicators at the start of a project, results in more awareness and positive effects.

- The socio-economic aspect is impacted positively by the projects, because coastal erosion threatens houses and livelihood, which are socio-economic aspects. The implemented NBS made it possible to sustain existing land use, and in some cases functions are brought back, like market gardening or add value like tourism.
- The environment is impacted positively by the projects. This is especially the case for the projects that are ecosystem restoration projects. Based on observed and current impacts at other projects, biodiversity is not actively enhanced. However, conditions for natural ecosystem restoration are improved. The projects had limited attention for resource efficiency and pollution prevention.
- The overarching indicators make clear that stakeholder engagement needs to take place in every project phase to make the projects successful. The ownership of the project needs to be with the local stakeholders and authorities to make it sustainable.
- The indicators that were selected for the various impact categories are not exclusively for that category, they have a relation with one or more categories.

Be aware that the number of cases that is analyzed is small and that this outcome may not be representative for all NBS projects in West Africa. On the other hand the outcomes are quite general and may therefore be relevant and applicable for many NBS projects along the West African coast.

In some interviews it came forward that 'indigenous people' has a negative association.

7 Conclusions

The objective of this project is to show the possibilities of coastal NBS in all WACA countries to solve problems like flooding and erosion in combination with nature conservation and restoration as well as being beneficial to societal challenges. Although NBS are still in an early stage in West Africa, a lot of projects are a lot of NBS projects are already being implemented. Lessons learned and impact of selected cases on a general scale are presented below and are based on a longlist of 30 cases with Nature-based Solution elements in 13 West African countries, from Mauritania to Nigeria, and in different landscapes: sandy coasts (dunes and beaches), muddy coasts (mangroves), rivers and estuaries, cities and ports. Seven cases were selected out of the 30 for phase 1 study which focus on the lessons learned and four of these seven for the phase 2 study which focus on both lessons learned and impact.

7.1 Lessons learned

The following lessons are learned from the selected cases:

- Technical and system knowledge
  - Have extensive (pre)feasibility studies on the physical and social-economic system of an area to find the best possible application of NBS and if NBS is the best way forward.
- Multi-stakeholder approach
  - All relevant stakeholders (government, community) should be included in all processes. That means a stakeholder assessment should be made before the start of the project.
  - Especially the local community should be involved from the beginning. This creates true commitment after project implementation and improves the sustainability of the project.
  - Most of the inhabitants that have to be involved require some form of financial support before they can take part in planting mangroves and plants, build groynes, and carry out maintenance works or other follow up post project activities.
- Management, monitoring and maintenance
  - It should be possible to adjust the design based on observations during the implementation and monitoring phase.
  - Most of the materials used for NBS such as mangroves or sand also have other uses for which they may be mined or harvested if the local population is not aware of the their benefit as part of a NBS.
  - Reserve (financial and procurement) space for multiple year monitoring and maintenance.
- Institutional embedding
  - Regulations in West Africa are generally not unfavorable for the implementation of NBS (contrary to in many other countries).
  - Projects that are implemented top-down encounter less issues with institutional embedding than projects that are implemented bottom-up.
- Business case or Funding
  - One of the main barriers for locally initiated projects was the availability of funds.
  - Most projects showed positive results and the potential to advance coastal resilience if properly implemented.
- Capacity building
  - Younger people (children or younger civil servants) are often more open and accepting to NBS than older people. This is an opportunity for upscaling NBS in West Africa.

- Other
  - The reasons to choose for a NBS varied: they were either the cheapest and easiest to implement at the beach with the help of inhabitants (wooden groynes Senegal), or the natural aspect of the project (Sandmotor Togo-Benin, PAPBIO Mangroves project, Dune restauration Senegal). For the Gambia Integrated Urban and Coastal Resilience Program, NBS was experienced as being a standard option within World Bank projects due to the added benefits.

7.2 Impact

Based on the four cases that are analyzed for the categories of social, socio-economic, environmental and overarching impact, the following is concluded:

- The society is impacted positively by the projects. Cultural heritage is protected by the projects and there is awareness of gender, youth and community health. In general, mentioning these indicators at the start of a project, results in more awareness and positive effects for example on involvement of children, youth, women as well as different stakeholders. Also education gets more attention.
- The socio-economic aspect is impacted positively by the projects, although the projects are often implemented because coastal erosion threatens socio-economic aspects. The implemented NBS made it possible to keep the existing land use, and at some projects functions are brought back, like market gardening, or value is added, like tourism.
- The environment is impacted positively by the projects often because the projects are restoration projects. Biodiversity is not actively enhanced, the conditions are made such that nature can restore. The projects had limited attention for resource efficiency and pollution prevention. Often a part of the project is to educate the public on biodiversity.
- The overarching indicators make clear that stakeholder engagement needs to take place in every project phase to make the projects work. The ownership of the project needs to be at the local stakeholders as well as authorities to make it sustainable. Climate resilience as well as Environmental and Social assessment, commitment and management were given limited attention in the projects.
- When enablers are given attention and are well implemented this enhances impact.
  - When stakeholders are engaged and capacity is built, more often children and youth are involved, who can become ambassadors for NBS.
  - When the enablers capacity building, business case and multi-stakeholder approach are applied often livelihood is maintained and in some projects diversified. The latter is often the result of multipurpose land use.
  - When monitoring takes place this is often monitoring of biodiversity, which strengthens that indicator.
  - When capacity building and system understanding strengthen climate resilience, the stakeholders know what the future threats and opportunities can be. For the sustainability of the solution there is a strong link with management, monitoring and maintenance, multi-stakeholder approach and institutional embedding. And stakeholder engagement is strengthened by a multi-stakeholder approach.

8 How to successfully implement NBS along the West African coast

The interviews show that Nature-based Solutions are being successfully implemented within individual projects in West Africa, each with their own approach. It is now important to capitalize on these successes, and thereby upscale and mainstream NBS in the West African coastal region. The main recommendation is to act according to the lessons learned as outlined in the conclusions with attention to the six enablers together with explicit attention for the impact of the projects in all phases as this maximizes the impact.

Subconsciously, many of the six enablers are incorporated in the implemented NBS projects to a more or lesser extent. However, each project has reinvented the wheel, developing their own approach and going through their own iterative process to implement a NBS. As an example, monitoring is organized differently in each project and every project has had to find their own way of making it work. This ability to learn-by-doing is one of the major strengths of the projects interviewed, and is inherent to the early stages of implementation of NBS in West Africa. To capitalize on the successes within implemented projects, it is important to combine the elements seen in practice with a more systematic approach. A more structured approach, sharing of knowledge and attention for impact and the enablers will make implementation of NBS easier and accelerate the mainstreaming of NBS in West Africa. These recommendations are described in more detail in the following paragraphs.

A specific recommendation for a follow-up of this inventory study is to hold more interviews: more in depth interviews to increase the understanding of existing NBS projects in West Africa as well as interviews with projects that were not selected. The recommendation is made as the interviews held during this study gave high-level results due to the limited duration of the interviews, the many topics and the limited number of people interviewed. The insights from the different interviews have also raised additional questions that could further sharpen the outcomes of these studies. More in-depth questions will provide more insights. A broader overview is developed when multiple people with different perspectives, not only technical, are interviewed. Also, all interviews are now done with members of the project team. It would also be interesting to include the perspective of local stakeholders or the government on implemented projects.

8.1 A generic 5-step approach

As described above, the enablers are part of many of the projects that have been investigated during the interviews. In many cases inclusion of the enablers has taken place through a reactive approach, where the problem is resolved as it is encountered and the best approach is discovered through learning-by-doing. This can be inefficient. Considering the early stages of NBS in West Africa, it is important that room for learning remains. This is also possible with a more structured approach. It is suggested to apply a generic approach, like the 5-step approach developed by EcoShape (Figure 11), which is based on many years of practical experience with development of

NBS by all the EcoShape partners. The approach is iterative and consists of the following steps, which are explained in more detail on their webpage[19]:

1. Understand the system (physical, ecological, societal
2. Identify alternatives that use or provide values for nature and humans
3. Evaluate each alternative to select an integral solution
4. Refine the selected solution
5. Prepare the solution for implementation

The approach is generic, but its implementation is location specific. When applying the 5-step approach, it is important to keep the six enablers in mind.

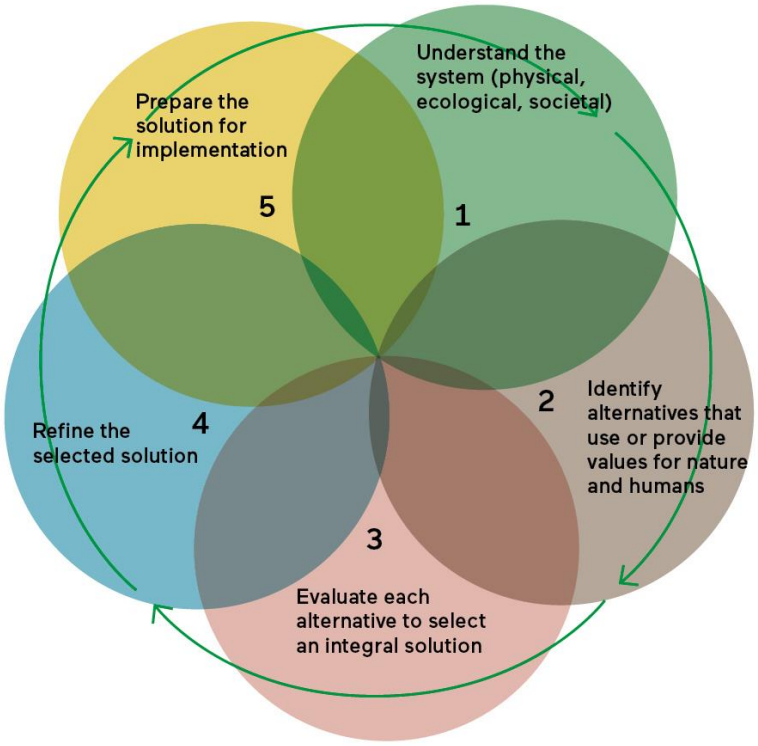


Figure 11 - Five basic steps for generating Building with Nature design ideas (EcoShape).

8.2 Share knowledge

Knowledge can be shared with the broader NBS community so that they can benefit from the lessons learned in implemented projects. In addition, experts should also be involved in all project phases. Both are essential for ensuring that experience gained through implementation of NBS is efficiently incorporated in the next generation of projects.

8.2.1 Disseminate knowledge

The main objective of this study is showcasing West African NBS examples to West African governments. Many governments are unaware of the possibilities for NBS in their region(s) and many implemented examples are unknown. The inventory has also shown that often limited

[19] https://www.ecoshape.org/en/the-building-with-nature-philosophy/five-basic-steps-for-generating-building-with-nature-designs/

resources are available online and that the information can be difficult to find. In three out of seven interviews it was explicitly mentioned that NBS projects should be able to learn from each other. It would be good to make information on NBS projects available with, for example, their lessons learned. This should include at least basic information such as the project location, a short project description, a visual impression and the implementing organization. Sharing of project information can be done in various ways:

- On the internet, for example via the website and channels of WACA and the World Bank as they are known by all West African partners. This can be done through a dedicated projects page with links to individual projects, or by embedding the webviewer and factsheets in the WACA website.
- Via the West Africa Regional Observatory Newsletter.
- Via the 2024 State of the Coast report (Bilan 2024).
- Via a new version of the compendium 'Coastal Management Practices in West Africa' (World Bank, 2022) with new NBS examples.
- Via a new version of the book 'Building with Nature' (Matthijs Bouw & Erik van Eekelen, 2021) with attention to West African examples.
- Through a web viewer that spatially illustrates where the NBS projects are located. This allows people to quickly find project in their region or in similar landscapes. The webportal can also be used for people to upload basic information on their own project in a pre-defined framework.
- Factsheets can act as a teaser, and show people at a glance that a lot is already happening. A factsheet also includes some basic project information and helps to give the reader a first impression of the project.
- Children have been mentioned multiple times as being open to the concepts of a nature-based approach. If the nature-based approach is embedded in education, children can act as ambassadors in the long-term.
- An online knowledge hub for NBS in West Africa can be setup with NBS guidelines and examples specific for West Africa. The setup could be similar to that of the EcoShape website specific for West Africa.

For dissemination highly visual appealing materials are considered most effective. For printed material consider sharing a digital version to reach a wider audience.

8.2.2 Involve experts

Experts should be involved in every phase of implementation of NBS to provide support and knowledge exchange. This includes not only technical and ecological experts but also socio-economic and institutional experts at a local, national, and international level. In all phases, involving experts will increase the probability for choosing a NBS which may be new and unknown to the team. By involving experts in the early phases (ideation, pre-feasibility, feasibility), there is more chance that a Nature-based Solution will be chosen or at least considered as an option. During the design and construction phases, involving experts will help to avoid pitfalls that other projects have experienced in the past.

8.3 Apply all enablers

Attention for all the EcoShape enablers improves the probability of successful implementation. In the following paragraphs, recommendations specific to each of the enablers are discussed.

8.3.1 Technology and system knowledge

Better understanding of the natural, socio-economic and institutional systems with improve the success of NBS. Here it is important to involve not only technical and ecological experts, but also socio-economic and institutional experts at a local, national, and international level. Where knowledge gaps exist, these can be filled through focused pilots and monitoring campaigns.

Better system understanding at the foundation of NBS initiatives can be enforced by establishing a shared physical-ecological vision for the West African coastline. This vision then gives the boundary conditions for any project (NBS or otherwise) implemented along the coast. This idea is discussed in more detail in section 8.3.4 on institutional embedding.

8.3.2 Multi-stakeholder approach

To facilitate a multi-stakeholder approach, the following approaches can be applied:

- An approach that that can be applied is the Dutch Dialogues[20] which is successfully applied in the USA at various locations with the support of the Dutch government. RVO-TIO is open to provide their experience with this approach to apply this collaborative process that involves all stakeholder in multiple workshops to creatively link spatial planning, integrated water management, infrastructure, and development.
- Another generic approach for sustainable coastal development is the Systems Approach for Port Development (SA-PoD)[21]. Coastal developments are complex and require a holistic approach based on thorough system understanding and active participation by all stakeholders. This approach consists of a systematic five steps process that integrates the systems: environment, society and economy. Each step capitalizes on the results from the previous one. They are iterative, achieving a higher degree of detail after every cycle. The focus is different per step:
    1. Problems and plans (needs and values) are identified for the port project and the larger area surrounding the port.
    2. Processes in the three systems mentioned above are investigated and the root causes of the problems are determined. Focus on the specific West African context and identify opportunities.
    3. Values and benefits are investigated, those that are under threat, lost and to be developed.
    4. Solutions are developed, that are on different scales and are technical as well as non-technical.
    5. Assessment of the different solutions with existing methods to come to viable, bearable and equitable solutions that are widely supported.

As mentioned earlier, to come develop sustainable solutions multi-stakeholders need to be involved, not only local stakeholders, but also regional, national and international stakeholders, governmental agencies and experts in the fields of coastal dynamics, ecology, socio-economics and institutional.

[20] https://wbae.com/projects/dutch-dialogues/

[21] https://drive.google.com/viewerng/viewer?url=https://www.wacaprogram.org/sites/waca/files/knowdoc/03.%2520WITTEVEEN%252BBOS.pdf and https://www.youtube.com/watch?v=OCUeWFtJNPg

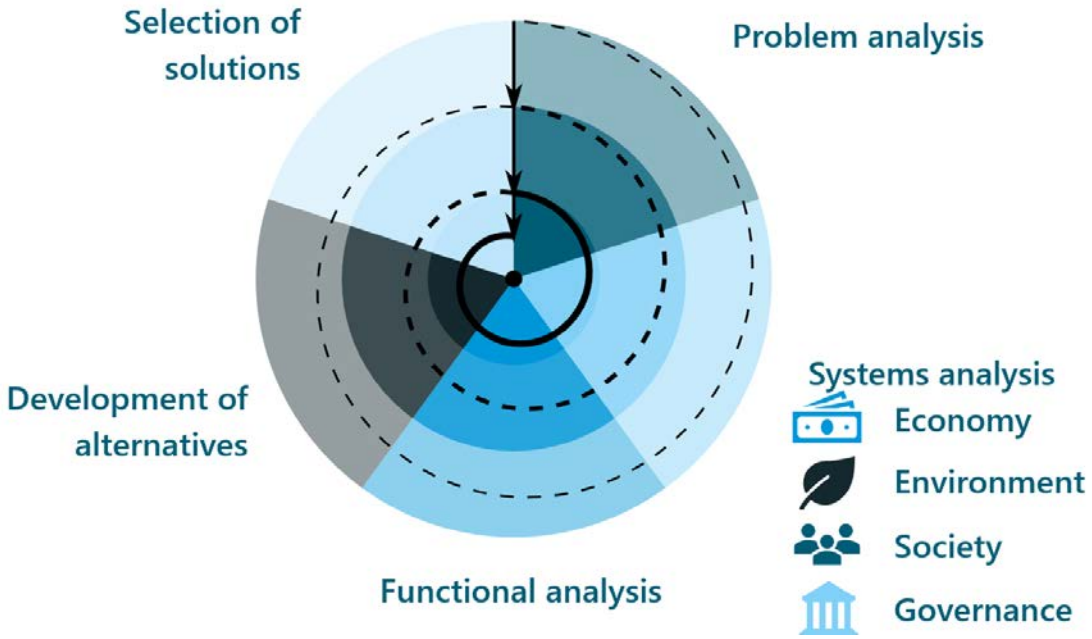


Figure 12 - Systems approach for sustainable coastal development.

One of the strengths of small-scale bottom-up projects is that they are rooted in the local community who may feel more ownership than for a top-down project. Early identification of local NBS ambassadors and accelerators is important, as their drive and close connection with the local community is very valuable. Once identified, WACA can offer support in the form of expertise, funding or exposure to maximize the effectiveness of the initiative while leaving the ownership with the initiators.

8.3.3 Management, monitoring and maintenance

In most projects, some monitoring is performed and the results are used to demonstrate the success of the project. In the interviews, the link between monitoring and maintenance did not come forward clearly. Using monitoring results to plan and scope maintenance will allow projects to progress towards adaptive management and become more sustainable. The first step in achieving this is making the link between monitoring and maintenance explicit.

8.3.4 Institutional embedding

Institutional embedding can help to ensure that certain aspects of a Nature-based Solutions are always included in the implementation process. Examples that come forward in the lessons learned which could be further embedded institutionally include:

- Not all projects perform a thorough impact assessment. The outcomes of the interviews show that explicitly including the expected impacts during the feasibility stage improves the results in terms of impact after implementation. Performance of an impact assessment can be stimulated by further embedding this in regulations.
- Monitoring and maintenance usually happens outside the main project period, making it more difficult to finance and organize. It would be valuable to reserve budget for this in every project.

- Most Nature-based Solutions are adaptive and their response is inherently uncertain to a certain degree. In the projects interviewed, regulations were not experienced as being a problem for NBS in particular. This is positive because in many countries outside West Africa, design standards make it difficult to choose a Nature-based Solution. Design standards are often developed for grey solutions and do not always give room for uncertainty. Any new regulations should allow for this uncertainty as long as the solution is sufficiently well monitored and maintained.
- In a more general sense, any strategies, development plans, regulations or standards that are developed should include NBS (green) options next to grey interventions.
- Institutional embedding is a strength of projects that are carried out top-down, but can be experienced as a challenge for bottom-up initiatives. Embedding can also form a platform for these initiatives. Take effort to find small NBS projects and embed them in the institutions. Also, when projects interfere, provide support as International Finance Institute to smoothen the bureaucratic process. Often when larger and smaller projects interfere, the smaller ones are overruled and disappear and their impact and the energy and drive of their initiators is lost.

Institutional embedding of a shared vision for the West African coast could also make it easier to initiate NBS projects that fit within this vision. There is currently no integral plan for the West African coast, and working together across countries can be difficult. Even so, it may be possible to establish a joint physical-ecological goal for the West African coast based on a thorough system understanding. This shared vision can form the boundary conditions for defining any projects that are carried out along the coast and will ensure projects are in balance with the coastal system. One of the conditions could also be that NBS should be considered as an option for any coastal project. Project implementation can then be done at the national level, thus avoiding the complexity of working across country borders. WACA could play an important role in establishing this joint vision by engaging its network and providing tools for the decisionmakers involved. For example, the WAC-app could be used for an initial discussion of the evolution of the West African coast under the influence of different coastal management strategies.

8.3.5 Business case

All projects that are interviewed for this study are funded through loans or grants from International Financial Institutions or donor organizations and not by the national government. In the long-term, it is desirable to move towards a business case without external funding. As most projects provide multiple benefits for society, this will require contribution from the various beneficiaries. This shift in funding would also confirm the commitment of national governments to a nature-based approach.

The business case can be further improved by making co-benefits (impact on all categories) a project objective. Valuing the co-benefits makes them a concrete part of the business case, which can be an advantage of green solutions over grey solutions when taking the life time into account.

8.3.6 Capacity building

Capacity building is an essential topic to successfully mainstream and upscale NBS along the West African coast. It is a topic which is overarching over the other enablers. For example the generic approach to develop NBS needs to be disseminated as well as the knowledge of the different systems or how multi stakeholder are involved in the development of NBS. The same counts for the

sharing of knowledge regarding monitoring, maintenance and adaptive management, embedding NBS in institutions and the development of viable business cases.

This capacity building needs to be done at many different organizations (e.g. World Bank, national ministries, knowledge institutions and universities). Whatever the topic, it is important that the training is customized per audience as every context is unique. Besides site specific content also the generic philosophy and approach need to be included. Each training needs to be hands-on with tangible examples.

Successful ways of capacity building are trainings as well as sharing knowledge via websites and guidelines as presented earlier.

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Appendix(es)

The following appendices are included in the report:

- Appendix A: A longlist of all the 30 NBS projects identified along the West African coast.
- Appendix B: Information on the seven interviews conducting including the information shared prior to the interview, the outline of the interview and an overview of the outcomes of each interview.
- Appendix C: Full-size images of the four coastal landscapes as defined by EcoShape.
- Appendix D: Factsheets on the seven NBS project selected for the interviews.
- Appendix E: The webviewer showing the location and basic project information of the 30 identified NBS projects.
- Appendix F: The memo on the selection of impact indicators.

A Longlist

This Appendix gives the longlist of NBS projects along the West African coast.

Project	Date	Project stage	Country	Land-scape	Problem	Type of NBS	Description	Size	Organisations involved	Funding	Website
Sand motor Togo-Benin	2022 - 2023	Complete	Benin, Togo	Sandy coast	Coastal erosion	Sand engine	Part of the WACA program. The current coastline has suffered from significant erosion, resulting in coastal retreat that serves as a threat to vital infrastructure and the livelihoods of the local population. A large volume of sand has been deposited at a strategic location and, over time, the natural motion of wind, waves and currents will spread it eastwards along the coastline. This principle of building with nature will reinforce the coastline in a robust and natural way.	Hard- (rock) and soft (sand) coastal protection constructions along a 14 km long cross-border section of coastline, with a 4 km long sand engine.	Boskalis (implemen-tation), Artelia (design)	WACA (54 million USD)	https://boskalis.com/media/ooudqtal/togo-benin.pdf
Epis Maltais	2018 - 2022	Complete	Senegal	Estuary, sandy coast	Coastal erosion	Natural groynes	Many villages in the Casamance river mouth suffer from coastal erosion, leading to loss of homes, loss of working space for fishermen, and salt water in agricultural fields. As a result, many young inhabitants are migrating to larger cities. With the support of of a retired economist, permeable groynes made of sticks and palm leaves are constructed by the local communities. These cause sand to be deposited, widening the beaches and providing more security for inhabitants.	1400m of beach in Diogué.	Community, GREF (Groupement des Educateurs sans Frontière)	Personal investment, French embassy (4000€)	https://iles-casamance.org/
Project PAPBIO	2017 - 2024	Ongoing	Senegal, Gambie, Guinea-Bissau, Guinea, Sierra-Leone, Liberia, Ghana, Togo, Benin	Mangroves	Climate resilience	Mangrove restoration	This umbrella project across 9 West-African countries (Senegal, Gambie, Guinea-Bissau, Guinea, Sierra-Leone, Liberia, Ghana, Togo, Benin) aims to enhance resilience to climate change through integrated protection of mangrove diversity and fragile ecosystems in West Africa.	49 projects subsidised in 9 countries, 70 people trained during visits organised by PAPBIO, 109 hectares of mangroves restored	IUCN, United Purpose, Wetlands International Africa, 5Deltas collective	EU grant with 8% cofinancing (€10 million total)	https://www.papbio.org/Accueil

Dune restauration in Saint Louis MPA	2014 - 2020	Complete	Saint Louis, Senegal	Sandy coast (sand spit)	Coastal erosion, flooding and salt intrusion	Dune restoration	A manmade breach made in 2003 in the sand tongue south of Saint Louis has lead to considerable erosion, with the breach growing upto 7 km wide. Flooding and salt intrusion of the hinterland caused villages and fields to be abandoned. To stabilise the sand spit and its dunes, permeable windbreakers made from natural materials (typhavelles) have been installed and reforestation (Casuarina equisetifolia plantations) has been carried out to capture the sand and rebuild the dunes in the Marine Protected Area (MPA) of Saint Louis.	150 hectares of reforestation, and 1.5 km of windbreakers	CSE (project management), SaVE (experts coastal protection), AMP Saint Louis (implementation)	FFEM (donor), WACA and French Coastal Protection Agency (technical support)	
The Gambia Integrated Urban and Coastal Resilience Program	2017 - present	Ongoing. Pre-feasibility complete in 2021.	Banjul, Gambia	Sandy coast, mangroves and urban	Coastal erosion, pluvial and coastal flooding	Beach nourishment, Urban NBS	To tackle the flooding problems, a number of hotspots have been identified within the Greater Banjul Area including the Kota stream which flows out of the city and the beaches on the west coast. Along the Kota stream, the sponge city approach will be applied by connecting green areas. This will reduce the volume and speed of runoff. Erosion of the beaches will be countered through nourishments and the construction of breakwaters, also benefitting tourism.	Integral project for the Greater Banjul Area	RHDHV (pre-feasibility), World Bank (technical assistance), Ministry of Environment (implementation), WACA (only Kota stream)	World Bank (grant for feasibility, loan for implementation) of 40-50 million USD in total	https://geowb.maps.arcgis.com/apps/MapJournal/index.html?appid=a7884f06912c4e73a73c49a9feebda68
Dune restoration, Mauritania (WACA ResIP)	2018 - present	Ongoing	Mauritania	Sandy coast	Coastal erosion, coastal flooding, salinisation of soils	Dune restoration	Using mechanical fixation with wooden sticks and biological fixation with plants, sand is trapped allowing the dunes to grow. The halophilic plant used (Sesuvium) was identified thorugh many experiments as being suitable under harsh conditions with limited water, high salt concentrations and strong winds. Pilots were done at three sites in Nouakchott, Nouadhibou and 25km south of Nouakchott.	10 hectares	ACNAV/ISSM (Académie Navale/Institut Supérieur des Sciences de la Mer), Ministry of Environment, WACA	WACA ResIP grant (phase 1: 58.500$, phase 2: 117.000$)	

Mangroves Sao Tomé en Principe (WACA ResIP)	2018 - 2024	Ongoing (implementation)	12 coastal communities (10 in Sao Tomé, 2 in Principe)	Mangroves	Coastal erosion and flooding	Mangrove restoration	The project focuses on enhancing the resilience of coastal communities. This involves building adaptive capacities in 12 communities that are highly susceptible to climate impacts. The actions include establishing a more robust early warning system, implementing safety measures at sea for fishers, and introducing interventions to protect the coastal areas such as plantation of mangroves in swamp areas to facilitate sedimentation, plantation of palm trees to stabilize the beaches against erosion, and stabilisation of dikes with vegetation.	40 hectares of mangroves	Ministry of Environment, World Bank/WACA, IUCN, Fundo Nordico de desenvolvimento, Union for protection of natural resources, E21, Directorate of forestry and Directorate of Biodiversity	WACA ResIP ($15 million)	https://storymaps.arcgis.com/stories/2b69b33c3c75482b86ec985e1dca6f49
Sandbar breakwater Nigeria	2018	Complete	Nigeria (Lekki)	Sandy port	Port sedimentation	Sand and rock breakwater, sand engine	Along this coast, ports experience heavy sedimentation at the western updrift side of the breakwaters, leading to the rapid burying of valuable armour rock. The Sandbar Breakwater concept is based on this principle by using natural accretion as the basis for the port protection. Such a concept is advantageous as a large sediment drift naturally supplements the sand filling works during construction and the required rock volumes are reduced significantly, saving construction time and minimising the environmental impact. To counteract the downdrift coastal retreat, a replenishable sand engine completes the scheme. The realisation of a Sandbar Breakwater at Lekki, Nigeria, in 2018, with subsequent safe and continuous port operations, proves the feasibility of the concept.		Boskalis, CDR	port authority / private	Paper: https://www.researchgate.net/publication/341533986_Sandbar_Breakwater_An_Innovative_Nature-Based_Port_Solution

Green Ghana Initiative	2021	Ongoing	Ghana	Various (coastal and inland)	Land degradation	Reforest-ation	The Green Ghana Project is a project launched in March 2021 by the Government of Ghana. The initiative forms part of the efforts by the Ministry of Lands and Natural Resources (MLNR) and the Forestry Commission to encourage Ghanaians to plant more trees to preserve and protect the country's forest cover and the environment in general. Planting of trees every year around June on the Green Ghana Day. The maiden edition of the Green Ghana Day was held on June 11, 2021, where the President led the entire nation to plant over seven million trees, exceeding the target of five million trees.	All over Ghana	Ministry of Lands and Natural Resources (lead), Forestry Commission (technical support)	Government of Ghana	https://greenghana.mlnr.gov.gh/
Mangrove Capital Africa	2018	Ongoing, unknown what is currently implemented. End year 2027.	Senegal, Tanzania	Mangroves	Biodiversity, storm impact and socio-economics	Restoration and safeguard	Mangrove Capital Africa is a ten-year programme led by Wetlands International and funded by DOB Ecology. Its goal is to safeguard and restore African mangrove ecosystems for the benefit of people and nature. The program will include capacity building and training.	Expect to restore 1 million hectares of African mangroves by 2027.	Wetlands International (lead)	DOB Ecology	https://www.wetlands.org/case-study/mangrove-capital-africa/
Rehabilitation and Extension of the Green Belt at Nouakchott	2000 - 2007	Complete	Mauritania	Sandy dunes	Sand encroachment	Dune restoration	With the active participation of the local population and technical support from the project, 50 hectares of dune ridge were mechanically stabilized and reforested. One linear meter of mechanical stabilization estimated at US$6.97.	Fixation of 50 hectares of dune ridge (or 600 linear metres).	FAO, Government of Mauritania	Wallonia (funding)	https://www.fao.org/3/i1488e/i1488e05.pdf

MPA Bouche du Roy creation in Grand Popo, Benin	MPA established in 2022		Benin	Lagoon with mangroves	Mangrove and fishery resources are threatened by human activities	Coastal ecosystems protection	The Bouche du Roy in the mouth of the Mono river near Grand-Popo is now a marine protected area. Through its recognition and creation, the government wants to secure the mangrove and fishery resources threatened by human activities. This is part of the WACA FFEM project (Nature based solutions and Coastal Risk monitoring in Benin, Senegal and Togo).		CSE, IUCN, FFEM, RAMPAO, MCVDD	FFEM	WACA-FFEM project: https://initiative-mangroves-ffem.com/en/west-africa-project-waca/
Epis Maltais (wood Groynes) in Dionewar, Senegal	2021	Ongoing	Senegal	Sandy estuary	Coastal erosion	Natural groynes and biological fixation of sand	Capturing of sand using wooden groynes and biological fixation through planting of trees to counter erosion northwest of the village of Dionewar. These works are part of TEFESS, an initiative of local communities for the protection and management of the coastal zone of Sine Saloum in Senegal. A similar approach is applied in the villages of Palmarin and Ngalou.	500m of wooden groynes and 1 hectare of reforestation.	Nébéday (NGO)	Global Climate Change Alliance+ (GCCA+/AMCC+), an EU initiative	https://www.nebeday.org/2022/06/mise-en-place-des-deux-premiers-epis-de.html, https://www.nitidae.org/en/actions/tefess-initiative-des-communautes-locales-pour-la-protection-et-la-gestion-de-la-zone-cotiere-du-sine-saloum-au-senegal

Reforestation on the Island of Djirnda in the Saloum	2003	Ongoing	Senegal	Mangroves		Mangrove restoration	Annual campaigns began in 2003 with support from projects implemented by IUCN and JICA. In 2008 an area of 1.5 ha was covered by Rhizophora. Despite the modest size of the reforested area, this action has a considerable impact in motivating people who pursue the restoration through an association of women for reforestation who are extending the surface every year.	1.5 hectares	IUCN, JICA		
Reforestation in Gagué Chérif	Unknown	Unknown	Senegal	Mangroves		Mangrove restoration	Several reforestation campaigns were conducted at this site. Due to high soil salinity results are rather disappointing. Mortality is high and survivors' growth is slowed. One reforestation day, mobilizing 100 people will cost 150,000 to 200,000 FCFA (about U.S. $ 333 to 445)		WAAME, JICA and UCAD		
River bank reinforcement and revegetation, Gbekon - Grand Popo, Benin	2021	Unknown	Benin	River	Flooding	Sand nourishment	Eroded areas are filled with sand dredged from the Mono river, leading to fixation of the river mouth. Fixation is further improved through planting of mangrove and coconut trees. Opening of a new mouth in another place and improved channeling of the water from the river enables a steady flow of river water to the ocean during heavy rains.		Ministry of Environement, WB		
Saly coastal protection project	Unknown	Complete	Saly, Senegal	Sandy beach	Coastal erosion	Beach nourishment and hard structure (breakwater)	Disappearing beaches are a major threat to the local economy, which is highly dependent on tourism. The beaches were brought back using sand nourishments and wave breakers.	Groynes and detached breakwaters built along 4.5km of coast	Van Oord	World Bank	https://magazine.vanoord.com/about-marine-ingenuity-15/saly

Saloum Delta	2004	Ongoing	Saloum, Senegal	Mangroves	Decline of freshwater, intrusion of salt water, over-exploitation of timber and fishery resources, land use changes such as clearance for agriculture, and ill-planned developments, such as offshore oil and gas exploration, and climate change.	Conservation and sustainable use	Conservation and sustainable use of mangroves for resilience against climate change, livelihood of inhabitants and ecosystem restoration. This includes replanting, management plans, 'Mangrove Platform', and dynamic monitoring system.	Possible overlap with other projects in the Saloum delta.	Wetlands International		https://www.wetlands.org/casestudy/conservation-and-sustainable-use-of-mangroves-in-the-sine-saloum-delta-senegal/
Revegetation, Parc National de la Langue de Barbarie, Senegal		Ongoing	Senegal	Sandy dunes		Dune rehabilitation	Casuarina equisetifolia planting to stabilize the dunes.		Ministry of Environment, WB	WACA ResIP	
IWRM, NBS and governance at various location along the Volta	2021	Ongoing	White Volta (North) and Lower Volta Delta (South), Ghana	River	Water quality, quanitity and safety	Mangrove restoration	Execute a Pilot of IWRM implementation by area orientated approach Songor Lagoon, starting with mangrove restoration in selected areas and involves stakeholder participation. Salt pans & mangroves.		Blue Deal (lead), Deltares (technical support)	Blue Deal	https://www.wereldwaternet.nl/en/our-projects/white-volta--volta-delta-ghana/
World Environment Day	2008	Complete	Shama, Ghana	Estuary	Coastal erosion and reduced fish stocks	Mangrove planting	Planting of 1000 mangrove seedlings on Anlo Beach, Shama as part of the activities marking World Environment Day. The planting of trees would help sustain and preserve fish stocks along the river estuary, which links directly into the sea in Shama.	1000 seedlings	Environmental Protection Agency		

Ada Delta and Anyanui, Keta Ramsar	Unknown	Ongoing	Ghana	Mangroves		Mangrove restoration	Restoration of mangroves along the coast of Ada and Anyanui. More than 100,000 seedlings have been planted so far.	100 000 seedlings	Sea Water Solutions (lead), Arocha Ghana & Ngo-Hen (technical support)		
Keta Sea Defence Project	1999 - 2004	Complete	Keta, Ghana	Sandy coast, lagoon	Coastal erosion and flooding, reduced sediment supply Volta river	Coastal setback/zoning, groynes, sand nourishment	The Keta Sea Defence wall was constructed in 1999 as a solution to the age-old erosion problem of the ancient coastal town and its neighboring communities. It involved a total of about 12 million cubic metres of sand and 1 million ton of rocks for the entire project. The project has four design/construct components namely: sea defence works to prevent erosion, a link road, a flood control structure and land reclamation. Coastline restoration and prevention of sea erosion is achieved with a combination of groynes and beach nourishments. Using a combination of groynes and revetments has led to increased coastal erosion of the downdrift coast.	Approximately 4km of coastline	Great Lakes Dredge and Dock Company of the United States of America (contractor), Baird & Associates and Messrs Conterra Limited (design and consultancy)	Exim Bank (US$83 million)	https://documents1.worldbank.org/curated/en/541981527661149414/pdf/Fighting-coastal-erosion-in-Keta-area.pdf
Bar beach of Victoria Island in Lagos, Nigeria	1969	Unknown	Victoria Island, Lagos, Nigeria	Sandy beach	Coastal erosion	Beach nourishment	The Bar beach downdrift of the piers protecting the port of Lagos experience extreme erosion.To avoid the impending collapse of commercial and residential buildings, federal and state offices and disruption of socio-economic activities on Victoria Island, artificial nourishment formula was used until a more permanent solution was found. The beach was scheduled to be artificially replenished at 2-to-3-year intervals, making it a costly option in the long term but it ultimately failed because it required continuous nourishment to stabilise the rapidly eroding beach.			Federal Government of Nigeria	

Mangrove restoration, Ouidah, Benin	2017 - 2021	Complete	Ouidah and Grand Popo, Benin	Mangroves	Deforestation	Mangrove restoration and sustainable management	The project seeks to restore and promote the sustainable management of the mangroves so that the coastal wetlands of Costa Rica and Benin can better mitigate and adapt to climate change. The project involves transferring the technologies and skills developed in Mexico to Costa Rica and Benin.	30 hectares	FFEM, ONG Corde, Benin Environment Agency	FFEM	https://initiative-mangroves-ffem.com/en/costa-rica-benin-project/
Mangrove restoration, Grand Lahou, Cote d'Ivoire (WACA ResIP)	2018	Ongoing	Grand Lahou, Cote d'Ivoire	Wetlands	Coastal erosion and over-exploitation	Mangrove restoration and sustainable use	The WACA program has implemented many initiatives to maintain and restore wetlands in the city of Grand-Lahou and its surrounding villages. One of these major initiatives is the reforestation of mangroves in the so-called wetlands of this region. These areas contain an incredible animal and plant ecosystem that is unfortunately disappearing due to the abusive exploitation of fishing and mangroves.	25 hectares	Ministry of Environment, WACA	WACA ResIP	https://www.wacaprogram.org/article/ivory-coast-waca-commits-restore-ecosystem-grand-lahou-wetlands
Mangrove restoration, Lake Boko-Zowla, Togo	Unknown	Ongoing	Lake Boko-Zowla, Togo	Mangroves, inland lake	Siltation of the lake, pluvial flooding	Mangrove restoration	To reverse the siltation process, and save the lake that feeds the many riverside villages, the West Africa Coastal Zone Resilience Investment Project (WACA ResIP-Togo), at the initiative of the Togolese government and supported by the World Bank, intervenes in the area by reforesting and planting mangroves along its perimeter.	100 hectares of riverbanks have already been reforested	Ministry of Environment, World Bank	WACA ResIP (210 million CFA francs, approximately €320.000)	https://www.togofirst.com/fr/social/2005-9999-waca-resip-depuis-anyronkope-operation-sauvetage-du-lac-boko-zowla
Keta Lagoon	Not yet	Concept/ Pre-Feasibility Study	Keta lagoon, Ghana	Lagoon with mangroves	Coastal erosion	Mangrove restoration, sand nourishment, dune revegetation	The project aims to improve ecosystem health and protect communities from erosion in the Volta Delta and Keta Lagoon. This will be done through the protection and restoration of mangrove forests; nourishment of sandy barriers; dune revegetation; and building of protective infrastructure such as groynes. Board Approval for the WACA program has been reached. Cabinet approval for the project is still pending before the loan agreement can be sent to Parliament for approval.		WACA (lead)	WACA ResIP 2 ($150 million)	

Strengthening human and natural systems resilience to climate change through mangrove ecosystems conservation and sustainable use in southern Benin	Unknown	Approved for implementation in 2022	Benin	Mangroves	Coastal erosion, decreasing natural resources produced by mangrove ecosystems	Mangrove restoration and sustainable use	The project will aim at increasing the adaptive capacity of human and natural systems to climate change through mangrove ecosystem restoration and sustainable use in southern Benin. The project will focus on the agricultural, forestry and fishery communities located in and around two 2001 assigned Ramsar sites.	120,000 ha of mangrove ecosystems under sustainable and climate resilient management, benefitting directly at least 250,000 women and men	GEF, LDCF, FAO, Ministry of Living Environment and Sustainable Development (MCVDD)	GEF ($30 million grant), FAO ($4 million grant), in-kind contributions from MCVDD and FAO	https://www.thegef.org/projects-operations/projects/10166
Great Green Wall (Grande Muraille Verte)	2007 - 2030	Ongoing	Senegal (and other countries south of Sahara)	Various	Desertification	Land restoration and reforestation	Restoration of degraded land across 22 African countries bordering the Sahara. Mainly inland but includes small stretch of coast in Senegal.	119,000 ha land area restored in Senegal	African Union (African Union Commission and the Pan-African Agency of the Great Green)	$33 billion needed, $15 billion committed	https://thegreatgreenwall.org/

B Interviews

This Appendix consists of the information that is shared prior to the interview, the outline of the interview and the summary of the interviews.

B.1 Information shared prior to the interview

In preparation of an interview the following is shared:

- Duration of 1 to 1.5 hours.
- Why the interviewee is asked.
- Explanation about Coastal NBS and how it is defined in this assignment.
- The question to already think about NBS in coastal areas in West Africa.
- The language that will be used, French or English.

B.2 Outline of the interview

For the interviews we see the following outline:

- Introduction (slide) (10 minutes)
  - Goal of project
  - Duration, recording, follow-up
  - Interviewers (organization)
  - Interviewee
- Coastal NBS definition/description (slide) (5 minutes)
  - What makes a solution a Nature Based Solution for you?
- Landscape of projects (slide) (5 minutes)
  - What landscapes are important to discuss?
- Possible cases (30 minutes)
  - Which cases can you share?
  - How were you involved? Who do we need to contact if we want to know more?
  - Was it implemented (project phase)?
  - What were the integral effects of the project (environment, society, economy)?
  - What were lessons learned (Barriers/enablers (slide))?
    - Why was an NBS chosen
    - Financing
    - Participation/cooperation
- Assessment framework (criteria, main take home messages of this NBS?) (10 minutes)
  - Components for publication
- Closure (10 minutes)
  - When your case is selected, we will contact you for further info
  - Who else to interview
  - Reference documents
  - Last remarks

B.3 Overview of interviews

See Appendix B3 which has been included as a separate document.

C Coastal Landscapes

Below are the full-sized illustrations of the four coastal landscapes as defined by EcoShape.

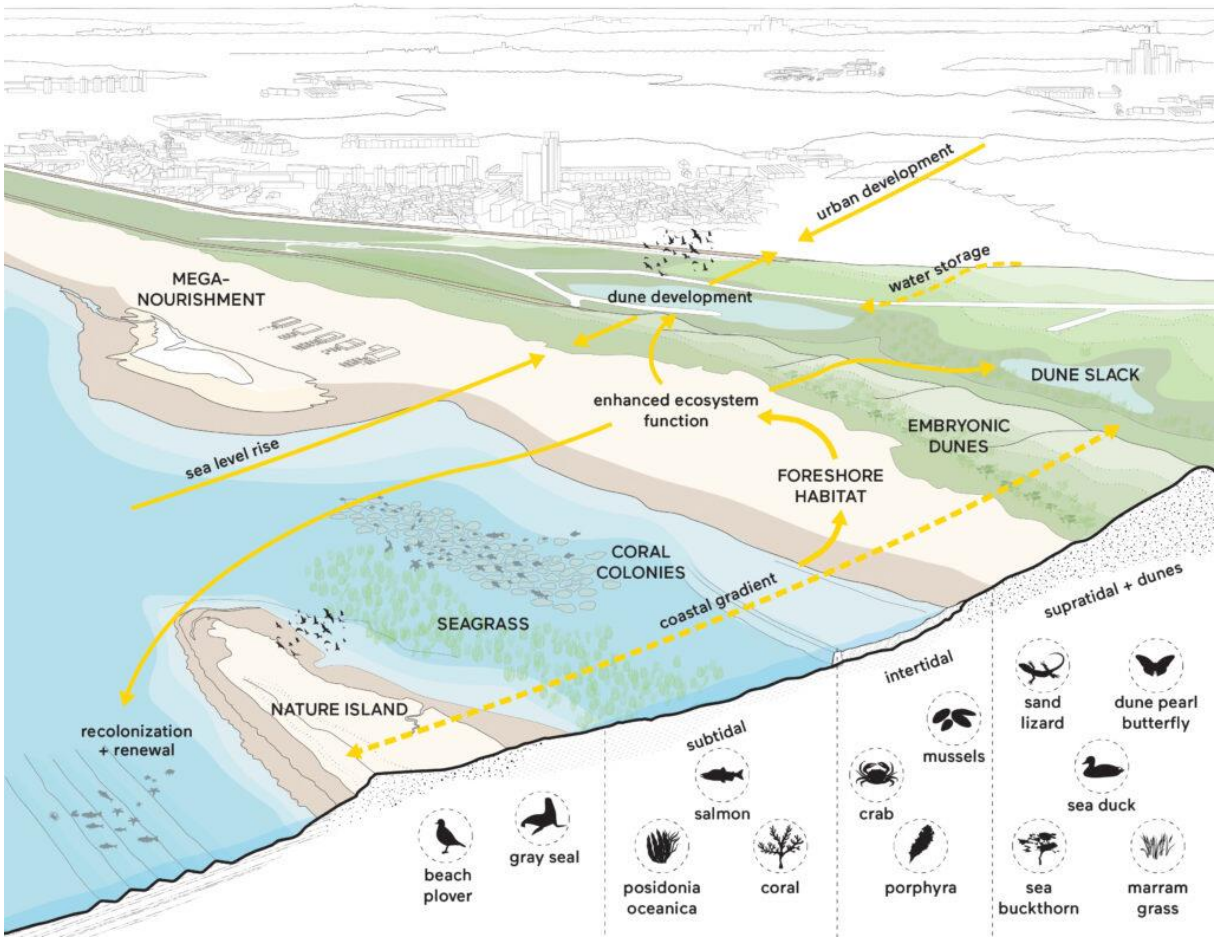


Figure 13 – Sandy coast.

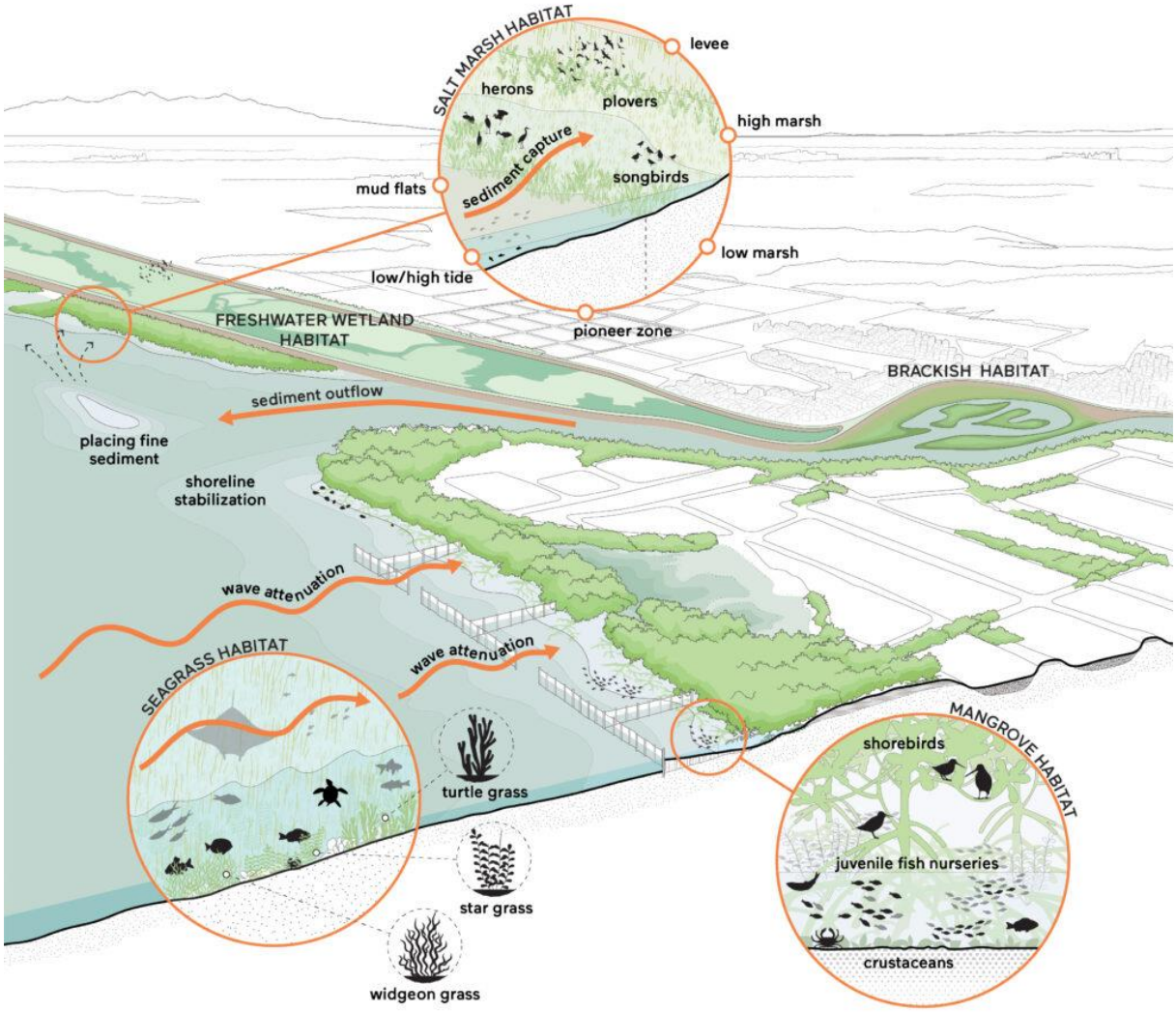


Figure 14 – Muddy coast.

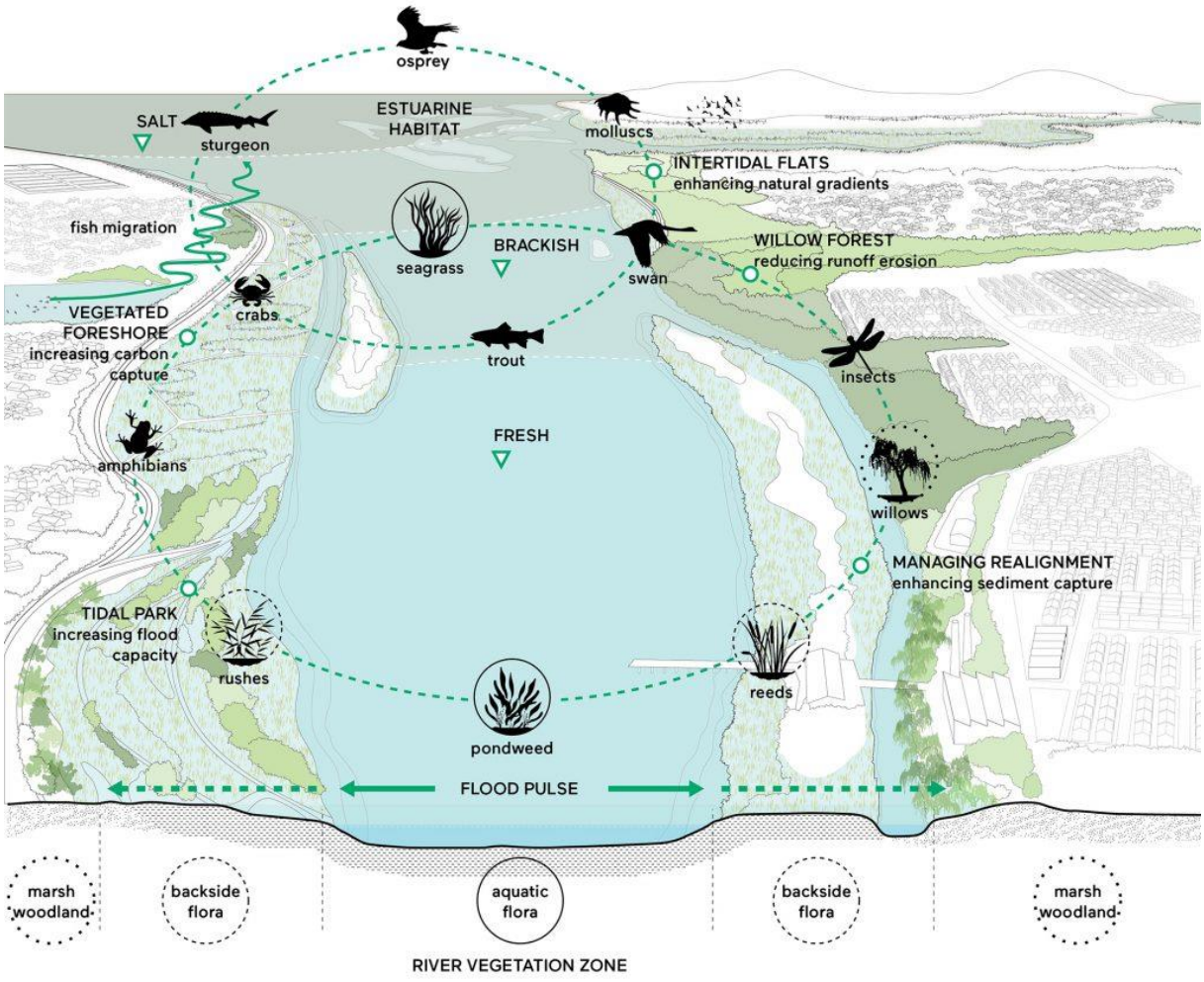


Figure 15 – Rivers and estuaries.

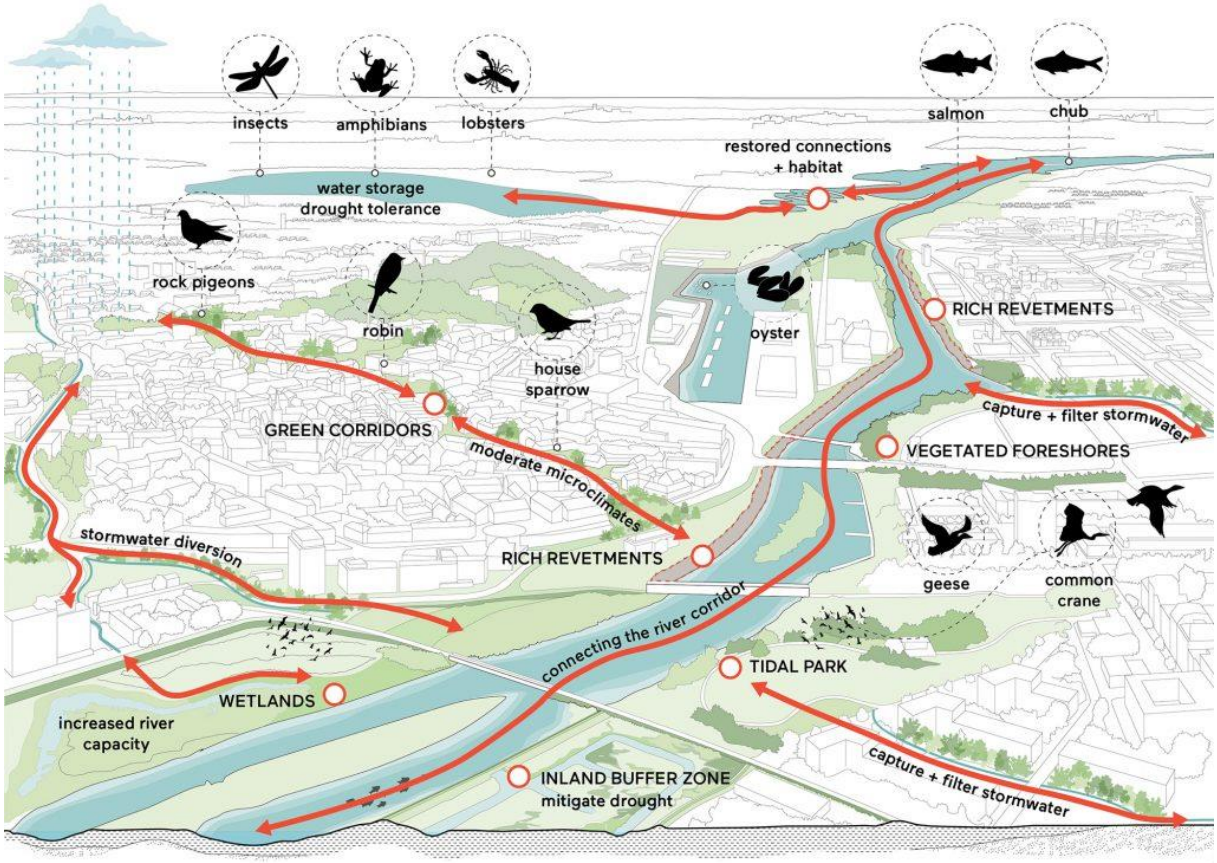


Figure 16 – Cities and ports.

D Factsheets

The seven projects that were included in the interviews are described in a series of factsheets that can be accessed with the following link. A preview of the factsheets is included below.

Dune restoration, Mauritania

2018 – present

"Artificial watering of young plants may be beneficial in the short-term, but not watering the plants stimulates growth of longer roots making the plant more resilient in the long-term."

Prof. Mahfoudh Taleb, Director ISSM/ACNAV

Problem

Erosion of the low-lying coastline has led to coastal flooding and salinisation of soils in both urban and agricultural areas.

Measures

Through a combination of biological fixation with the Sesuvium plant and mechanical fixation with sticks, sand is trapped allowing the coastal dunes to grow.

Effects

Overall, the results are good with the dune cordon raised significantly in certain areas. However, the dunes remain fragile in the sites with shells encountered in breaches.

Lessons learned

There are few plants that can survive in such a harsh environment. Through a series of experiments, survival rates of the Sesuvium plant were improved from 5% to 95%.

Factsheet **1**

Dune restoration in Saint Louis MPA

2014 – 2020

"Learn and be adaptive during the project"

Moussa Sall, Project Lead CSE

Problem

Coastal erosion has caused flooding and salt intrusion of the hinterland where villages and fields have been abandoned.

Measures

Permeable windbreakers made from natural materials (typhavelles) and reforestation captures sand, allowing the dunes to grow and stabilizing the sand spit.

Effects

There is a net widening of the beach. Also, the sand trapped by wind breakers has stopped seawater from overtopping the dunes.

Lessons learned

Implementation and learning in parallel can be very effective. Also, NBS can have considerable co-benefits for nature conservation.

Factsheet **2**

Project PAPBIO C1-Mangrove

2017 – 2024

"It is very important to know your area. Each area is different."

Paul Tendeng,
Project Coordinator IUCN

Problem

Mangrove populations in West Africa are declining. They form an important source of natural resources and offer protection against coastal flooding and erosion.

Measures

This project aims to enhance resilience to climate change through integrated protection of mangrove diversity and fragile ecosystems in West Africa.

Effects

49 projects subsidised in 9 countries.

70 people trained during visits organised by PAPBIO.

109 hectares of mangroves restored.

Lessons learned

It is important to involve stakeholders in all stages of the project and to have continuous exchange with the community for true commitment to the project.

Factsheet **3**

The Gambia Integrated Urban and Coastal Resilience Program

2017 – present

"It is a nice transition that Nature-based Solutions are becoming the default way of working."

Scott Ferguson, Flood Risk Specialist
World Bank

Problem

Banjul is exposed to both pluvial and coastal flooding, made worse by coastal erosion.

Measures

The sponge city approach where green areas are connected will reduce the volume and speed of runoff. Coastal erosion is countered with nourishments and breakwaters.

Effects

The pre-feasibility is complete, and the project is awaiting implementation. The intended effect is reduced flooding as well as an improved living environment and co-benefits such as tourism.

Lessons learned

The 'devil' will be in the details as time for implementation is limited and any delays can become problematic.

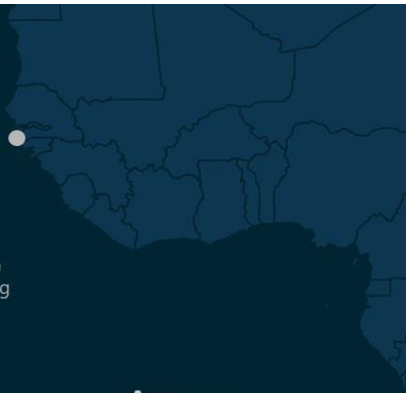
Factsheet **4**

Wooden groynes Epis Maltais

2018 – 2022

"Children can be ambassadors for NBS techniques. They embrace the underlying concepts, while some adults feel safer when protected by grey infrastructure."

Patrick Chevalier,
Initiator and Project Lead



Problem

Many villages in the Casamance river mouth suffer from coastal erosion, leading to loss of homes, loss of working space for fishermen, and salt water in agricultural fields.

Measures

Permeable groynes made of sticks and palm leaves are constructed by the local communities. These cause sand to be deposited, widening the beaches.

Effects

Between May 2022 and December 2023, the beach in Diogué has expanded seaward with 40 meters. A wider beach provides more security for inhabitants.

Lessons learned

Maintenance is important and can be made easier for the community by using local materials and arranging structural compensation for a few individuals.

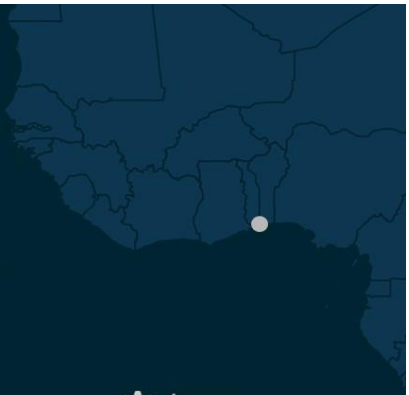
Factsheet **5**

Sand engine Togo-Benin

2022 – 2023

"One of the reasons Benin chose a Nature-based Solution is that a sand engine could replenish the whole stretch of coast up to Cotonou in Benin"

Pieter Boer, Regional Manager Boskalis



Problem

Coastal erosion is a threat to vital infrastructure and the livelihoods of the local population.

Measures

A large volume of sand has been deposited and, over time, the wind, waves and currents will spread it eastwards along the coastline. This is combined with hard measures in the form of 18 groynes.

Effects

The beach was eroding by up to 10 meter per year. Following construction already some 50 meter of additional coast has been established. The sand engine should last 10 years.

Lessons learned

Interaction between the groynes and the sand engine is important. Also, the sand engine should be built with a smooth shape.

Factsheet **6**

Coastal resilience Sao Tomé and Principe

2018 – 2024

"Learning from existing projects is important. We received help from experts on mangrove restoration from Senegal."

Abnilde de Ceita Lima, responsible for WACA ResIP projects in STP

Problem

Many coastal communities in Sao Tomé and Principe are exposed to coastal erosion and flooding.

Measures

Interventions to protect the coastal areas include plantation of mangroves in swamp areas to facilitate sedimentation and plantation of palm trees to stabilize the beaches against erosion.

Effects

40 hectares of mangroves have been restored in four communities, improving flood safety. People living in the areas which are most at risk will relocate to safer areas.

Lessons learned

Also with limited financial resources, NBS can make a difference.

Factsheet 7

Ideas? Share them with our team.

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E Webviewer

All 30 projects listed in Appendix A are displayed in the webviewer which can be visited with the following link. A screenshot of the webviewer is included below.

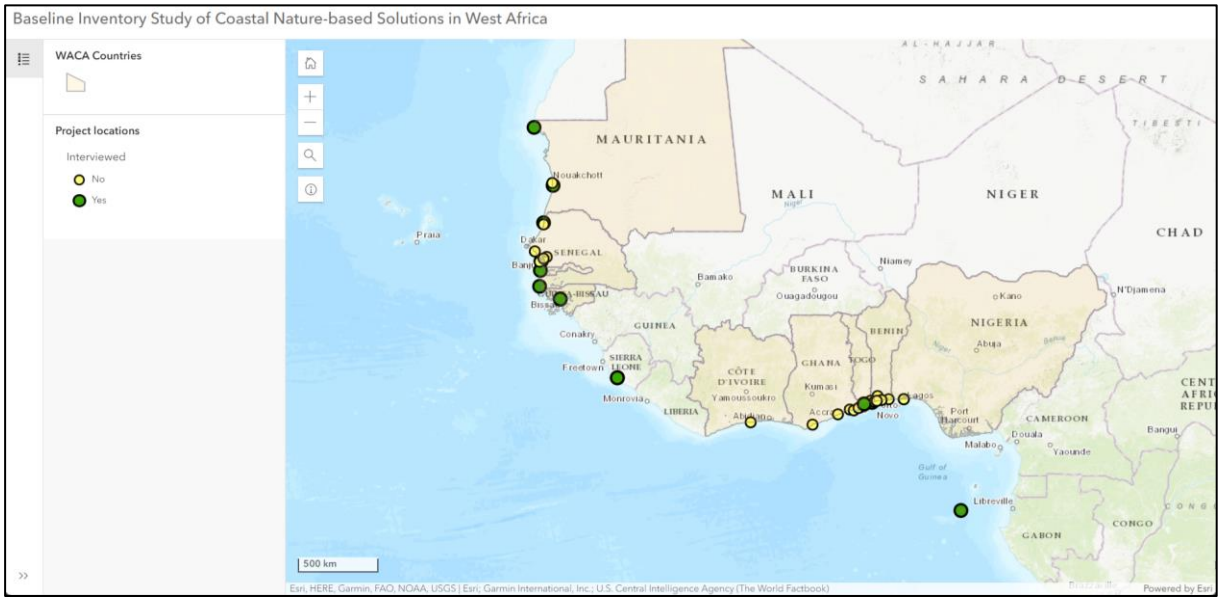

Figure 17 - The webviewer including the 30 NBS projects along the West African coastline identified during this study. Projects which have been interviews are shown in green, and remaining projects in yellow.

F Selection of impact indicators

See Appendix F which has been included as a separate memo.

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