



NbS Fundamentals

Considerations on the implementation
of NbS

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Summary

The application of Nature-based solutions (NbS) requires a basic understanding on the core principles and essential characteristics of NbS to effectively be implemented. A common language and agreement on the principles and characteristics is necessary to achieve a solution that can be applied on a broad scale.

NbS are characterized by multifunctionality, adaptivity, alignment with the natural system while addressing societal problems and providing socio-economic benefits. NbS are part of a system, and should not be seen as a standalone fix for a specific problem. NbS can fulfill a variety of functions, most of which are not always valued monetary/ in the economic sense. Also, NbS provide a range of benefits that need to be considered and can be used as argument for implementation.

A NbS can be a hard-engineered solution while still integrating natural processes in the solution. There is not one type of NbS, but a spectrum, which includes full natural solutions but also allows space for natural processes in hard grey solutions. The nature in NbS is meant on the line of including natural processes and increasing biodiversity. Hard-engineered solutions can in specific instances be the more logical choice than a fully natural solution; however, natural processes can be integrated in the system.

Currently, NbS are implemented in multiple places. Still, they are not the standard yet, but tested on pilot sites where they can grow, and knowledge can be acquired. Pilots can lead to upscaling, integrating NbS into systems globally where eventually they can become the standard. Unfortunately, as of today NbS are facing barriers. NbS are facing barriers on three systems, the natural, social and governance system. Also, mindset towards NbS needs to change.

In the International Guidelines on Natural and Nature-Based Features for Flood Risk Management (NNBF guidelines) an elaboration is given on different phases for project management of NBS implementation which can help in overcoming barriers. The different phases are scoping, planning, decision-making, implementation and operations or realization. In these phases, barriers can be identified, and a solution can be sought. The enablers of Ecoshape can also provide help in overcoming the barriers of implementing NbS. The enablers provide aid in identifying key considerations when it comes to NbS implementation.

A change in mindset is also required when it comes to NbS implementation. When it comes to mindset change, Nature-Based Thinking (NBT) can be one of the methods to drive this change. NBT builds on the relations and integration of the natural, social and governance system. Systems need to work together instead of being individual components. Educating for change is a crucial part of NBT to stimulate the desired change. Next to NBT, Palomo et al. (2021) identified four main elements (next to more elements) to catalyze transformative change towards NBS: Nature's values, knowledge types, community engagement and nature management practices. Finally, ISBAM further elaborates on a different way of looking at a system. Success stories of NBS implementation are a way to show the public why NbS are a way to improve society, which can lead to gaining awareness in a broader context about NBS and their necessity. Nudging current mindset towards a more nature-inspired mindset, where the natural aspects of the system are regarded, can lead to broad scale application of NbS instead of falling back into the current traditional methods.

When applying a system-based approach, regarding the system rather than a single component, while making use of multidisciplinary knowledge to grasp the complexity of a system, societal problems can be addressed in the form of NbS.

Introduction

Nature-based solutions (NbS) are being applied in many areas, with a lot of fragmented knowledge and information. To actively implement, upscale and mainstream NbS, a basic understanding of their characteristics, benefits and impediments is necessary: the NbS fundamentals. This document reflects on the definitions and characteristics of NbS for the MANABAS COAST project applicable in the North Sea region, followed by an explanation of the implementation of NbS including opportunities and barriers. A transition in way of working and thinking is required for successful implementation and mainstreaming of NbS. The purpose of this document is to provide the first handles to activate professionals in the public and private sector to implement NbS within their projects and organizations. This document is written as part of work package 1 (WP1) of the MANABAS COAST project, working on the framework encompassing different elements of mainstreaming and upscaling NbS such as NbS fundamentals for Flood and Coastal Risk Erosion Management (FCERM).

This document starts off with the NbS fundamentals, followed by the NBS definition showing NbS characteristics (coupled with the MANABAS principles), functions and benefits. The spectrum of NbS solutions and their link with nature is explained, followed by their coupling in the MANABAS project. Next, implementation of NbS is discussed, where the mainstreaming is discussed, and barriers are shown and solutions for these barriers are provided. An example being the Enablers drawn up by Ecoshape, used for the MANABAS project. Finally, a change in mindset is described, highlighting Nature based Thinking (NBT) and Integrated system-based asset management (ISBAM), followed by conclusions and the way forward.

NbS Fundamentals

In recent years, NbS have emerged as a transformative and innovative approach to addressing complex challenges posed by climate change, biodiversity loss and urbanization. NbS integrate natural processes and ecosystems to provide cost-effective solutions, benefitting both people and the environment (Xie et al., 2022). For further mainstreaming NbS, understanding and capturing the essentials of NbS is crucial for implementation of sustainable and effective strategies. NbS are implemented in a variety of different social, political, and natural contexts, making it difficult to draw lessons that can be applied to another NbS project. Methodologies differ, research has been done differently and cases vary widely due to geographical setting. Also, professionals often face multifaceted environmental challenges, where NbS can offer holistic approaches addressing multiple issues.

The NbS fundamentals are designed to provide professionals with handles to further broaden their horizon when it comes to NbS implementation, stating its characteristics but also barriers and proposed solutions. Professionals that are equipped with NBS fundamentals can design interventions that are both flexible and resilient, enhancing viability of projects. Also, being aware of multiple benefits arising from NbS helps in identifying the best possible approach. There is a lot of uncertainty and confusion when it comes to NbS, where the NbS fundamentals can help in providing clarity along the way. Knowledge from NbS fundamentals provides a base for designing and implementing adaptive and resilient solutions that integrate the natural, social and political system.

Next to the NbS fundamentals, MANABAS COAST will provide tools and handles derived from its pilots in the form of monitoring results, best practices for a variety of subjects, insights on a common language and a lot more.

NbS and insights from previous projects

The Nature conversancy (2024): 'As the world adapts to the era of climate change, we must find solutions that build resilient, adaptive systems. Nature-based solutions can help'.

When looking at the definition of a NbS, there is not a one-size fits all. However, there are many fundamentals in the definitions that can be recognized and highlighted. Zooming in on the European Commission definition (as used for MANABAS) for NbS, being “*Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions*”, it can be seen that there are a lot of different elements present, needing explanation for a thorough understanding of a NbS.

NbS have multiple characteristics, summarized by the German Environmental Agency (UBA) (2021) as the following:

- NbS are aligned with the natural system
- NbS are benefiting biodiversity
- NbS are locally appropriate (taking into account the system)
- NbS address societal challenges
- NbS are adaptive and multifunctional (providing multiple benefits)
- NbS provide benefits to human well-being.

Sowińska-Świerkosz & García (2022) cross-referenced and reviewed 20 definitions of NbS and identified that NbS are interventions that:

1. are inspired and powered by nature
2. address (societal) challenges or resolve problems
3. provide multiple services/benefits, including improvement of biodiversity
4. and are of high effectiveness and economic efficiency

Furthermore, in a document published by the European Commission (2021), five questions determining whether a solution/action can be deemed as a NbS are framed as the following:

1. Does the NbS use nature?
2. Does it provide social benefits?
3. Does it provide economic benefits?
4. Does it provide environmental benefits?
5. Does it have a positive impact on biodiversity?

Summarizing the characteristics, it can be seen that NbS should fit the natural system. The natural system is always either in balance or moving towards a new equilibrium. The designated NbS should fit the balance or desired trajectory in which the natural system is moving. Implementing a dune system in a natural system that is not accustomed to dunes, their dynamics and biodiversity impact, will lead to an undesired equilibrium shift, with (possible) detrimental effects on the natural system.

Tailoring NbS to address societal problems is crucial for implementation, as the social setting determines whether the NbS is implemented. Global modern society, especially the democratic part, has its decision-making process designed in such a way that the social system is key. Without societal support, decision-making will not move towards NbS implementation. However, if the NbS addresses societal problems, society will be eager to work towards implementation. Besides addressing societal issues, NbS also provide a variety of benefits. As biodiversity is decreasing worldwide with detrimental effects (Rafferty, 2024), one of the benefits NbS can provide is the increasing of biodiversity, tackling the diminishing of species. However, policies and laws should not be disregarded. Just as long-term benefits need to be taken into account when looking at the short-term costs.

In addition, adaptivity and multifunctionality are aspects that comes forward often when it comes to NbS. NbS are implemented in a fluctuating system, where components are constantly moving. In order to work

effectively NbS need to be able to fit in these dynamics, hence a rigid solution is often undesirable. In addition, with a complex system, multifunctionality is key to work and fit the system.

Coming back to the European Commission checklist, a good example providing a ‘Yes’ for each question (2021) would be the building of dunes to improve flood protection in the North Sea region where socio-economic and natural system are both taken into account. The dunes are inspired and powered by natural processes, address challenges such as flood risk, improve biodiversity of the system as species use the dunes for habitat and food, can be used for recreational purposes, and are highly effective for their purpose.

Looking at the MANABAS COAST project, principles are defined to create a common understanding on NbS in the MANABAS COAST project context. As can be seen in figure 1, the natural system and its dynamics come forward, just as the societal system (including stakeholder involvement), multifunctionality and adaptivity. A further explanation on the MANABAS COAST principles and how they are developed can be found in the report by Pluis (2024).

| # | NbS principles MANABAS | System | | |
|-----|---|----------------|---------------|-------------------|
| | | Natural System | Social System | Governance System |
| I | Embrace natural dynamics on different temporal and spatial scales | | | |
| II | Apply a holistic systems approach to address ecological, institutional and societal challenges | | | |
| III | Combine multiple functions and provide benefits for people and nature for present and future generations | | | |
| IV | Involve stakeholders throughout the entire project, ensuring transparency, commitment, and shared ownership | | | |
| V | Support adaptivity in management, maintenance and practice | | | |

Figure 1: NbS principles defined for the MANABAS COAST project

Functions and benefit

Planbureau voor de Leefomgeving (PBL) (2022):
‘NbS can help generate multiple benefits for society, such as food and water security, climate mitigation and adaptation, while addressing biodiversity loss. This is their unique selling point’.

NbS can play many different roles filling in many different functions. As mentioned before, NbS should not be designed for one specific problem with one specific function, but should fulfill multiple functions in a system.

Looking into the different functions a NbS can provide, Mok et al. (2021) define eight main functions for NbS:

1. Cooling
2. surface water regulation
3. water purification
4. air purification
5. biodiversity
6. socio-cultural services
7. provisioning services
8. climate regulation

These functions can be labeled under the ecosystem services, which are categorized in 4 categories (IUCN NL, n.d.):

1. Provisioning services
2. Regulating services
3. Cultural services
4. Supporting services

These defined functions can help in providing additional value to the benefits a NbS provides. This in turn helps in showing the benefit of an NbS which is hard to describe to a monetary value. NbS provide many benefits, most which are unknown to the public, private and civil society. In addition, while a NbS can help in regulating climate, it also leads to less CO₂ production as the non-NbS variant (especially in coastal protection) usually is made from products that contribute to a lot of extra CO₂ (Rong et al. 2022). Moreover, salt marshes for instance have the potential to mitigate climate effects by capturing so-called blue carbon. For the MANABAS COAST project, NbS provide an important service in the form of coastal erosion and flood risk management, which fall under the socio-cultural as well as the climate regulation services.

A good example to show the benefits of the implementation of NbS is salt marsh construction at the Ems, a river running through the Northwestern part of Germany and the Netherlands. The Ems ends in an estuary system in the North of the Netherlands.

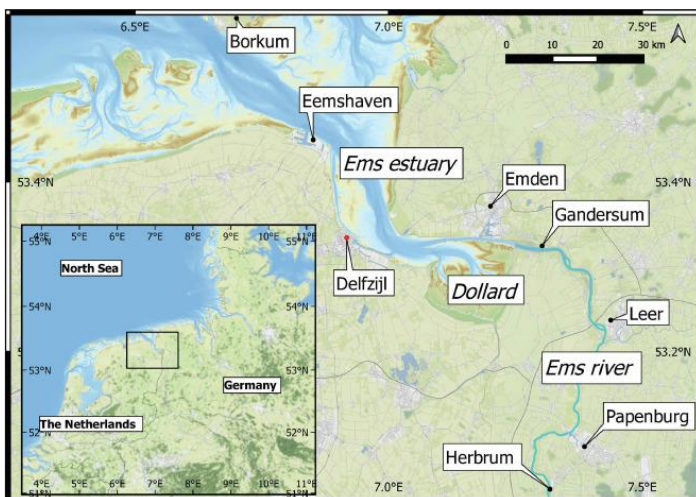


Figure 2: Ems system in the North of the Netherlands (Baptist et al. (2021).

The salt marshes in the area improved the biodiversity and water quality, while simultaneously providing protection against flooding and salt-water intrusion. Biodiversity increase should be taken into account for the cost-benefit ratio to show true costs and benefits of choosing a NbS over traditional methods. Also, the vegetated saltmarshes provided socio-cultural services, as locals and tourist were eager to visit (Baptist et al. 2021). The project followed the IUCN principles, fitting into the governance system while benefitting the socio-cultural and natural system.

Nature (based solution)

O’Sullivan et al. (2020):

“The Nature-Based Solutions (NbS) concept is the most recent entry in discussions around how ‘nature’ can be mobilized to render urban areas more resilient to the threat of climate change.”

When narrowing it down, the nature-based solution website incorporates the phrase ‘inspired by processes and functioning of nature’ ([What are Nature-Based Solutions \(NBS\)? | Nature Based Solutions](#)). Processes of nature already separate certain actions in the building landscape, as concrete and bricks are not created through natural processes but by processes invented and executed by people and their machinery. Grey infrastructure without implementing a natural process or functioning of nature can thus be disregarded as

NbS. This does not mean however, that a grey infrastructure cannot be (come) a NbS by implementing natural aspects to the present grey infrastructure.

An example for grey infrastructure combined with NbS is the Afsluitdijk project, which is a pilot in Manabas. Here an ecotoplayer was added to the concrete Levvel blocs which are situated on the bottom slope of the revetment on the Wadden Sea site. The ecotoplayer exists of a roughened toplayer and 2 notches, so seaweed can grow on it and shrimps, small butterfish and mussels can use the notches as habitat.

In the International Guidelines on Natural and Nature-Based Features for Flood Risk Management (NNBF guidelines) (Bridges et al., 2021) the different forms of Flood risk management systems are described, showing a range for integration of the natural system.

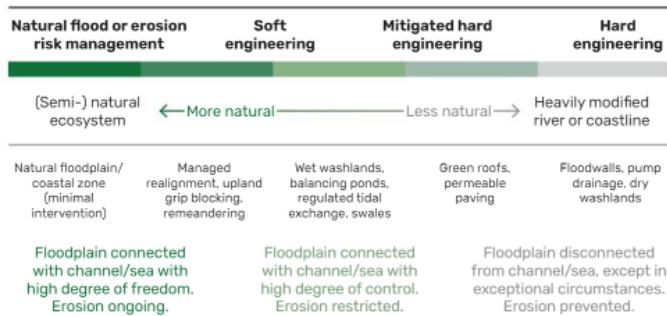


Figure 3: Spectrum of Flood risk management systems (Bridges et al. (2021), modified from the Environment agency (2010).

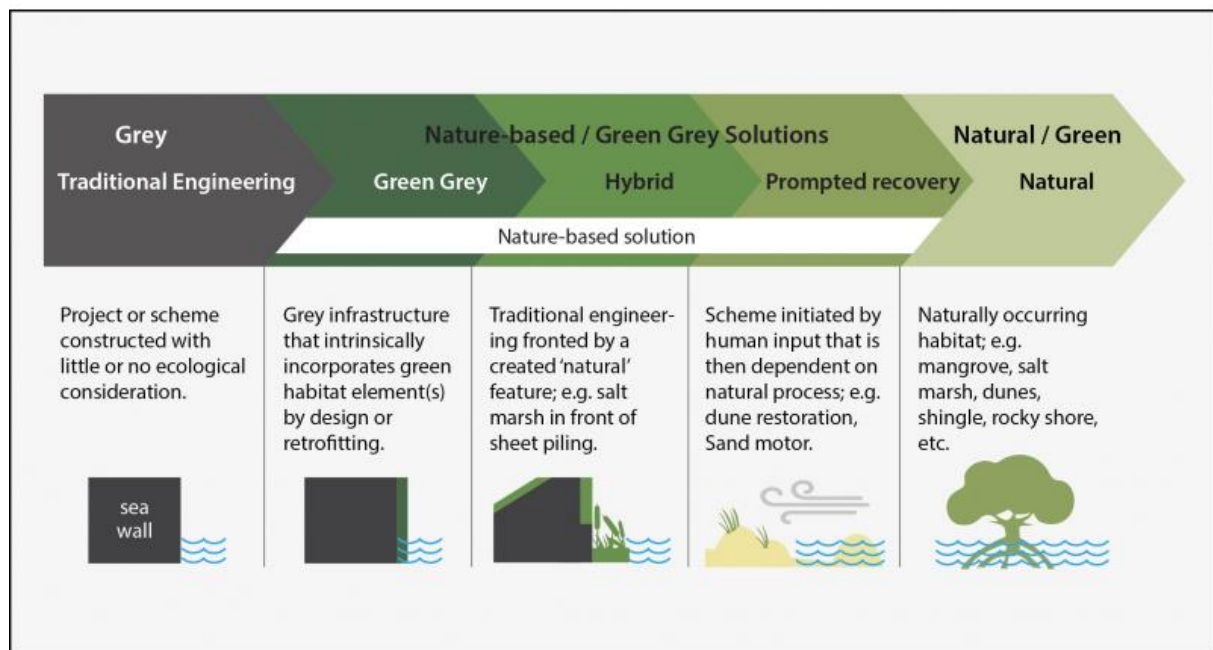


Figure 4: Greening the grey; a framework for integrated green grey infrastructure

A NbS can be a hard engineering construction, serving the purpose of diverting flood risks, but still leaving space for the integration of natural components as shown at the Afsluitdijk renovation project (<https://www.rijkswaterstaat.nl/water/projectenoverzicht/afsluitdijk>). While the green grey infrastructure is being renovated to ensure flood protection in the dense populated areas of the Netherlands, natural processes are being incorporated where they were disregarded at first. Grey infrastructure is designed to work complementary with the natural system, providing space for plants and other species present.

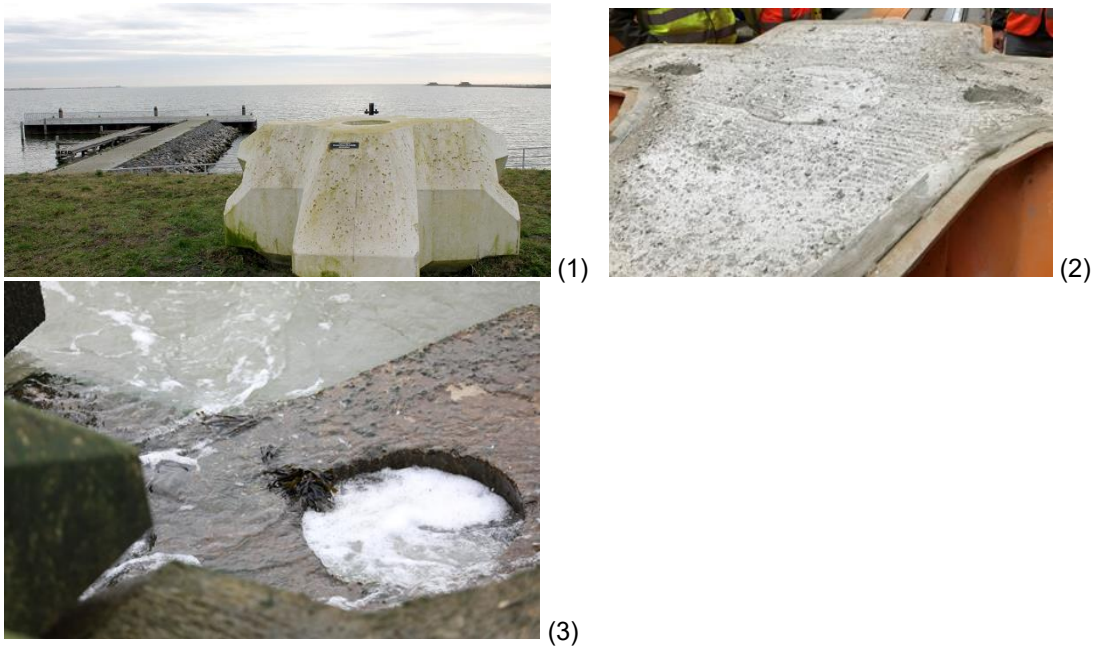


Figure 5: New concrete blocks of the Afsluitdijk designed to improve plant growth and leave space for (aquatic) life as part of the renovation project (photocredits: GWW-Bouw), second picture showing the ecotoplayer on the level blocs and the third showing bladder wrack growing on the ecotoplayer.

Focusing on the first part of the definition and name for the solution, a crucial component of the NbS is nature and natural processes. As the name says, the solution uses natural components. Nature however is a very broad term, to the extent that some characteristics need to be described.

Nature, as used in the MANABAS COAST context, can best be described as the state of a functioning ecosystem with as limited human intervention as possible. As mentioned earlier, the NbS should tackle challenges/ resolve problems. In this complex world a lot of complex challenges and problems arise, for which NBS can play an important role to overcome them.

Link with MANABAS COAST and FCERM

MANABAS COAST stands for MAInstreaming NAture-BASed Solutions through COASTal systems. NbS are already being implemented through coastal systems, however this tends to happen in a limited amount and is not yet standard common practice.

When looking at the MANABAS COAST project, the main functioning that is essential when it comes to the NbS, is that of (surface) water regulation, socio-cultural services, provisioning services and climate regulation. Where the MANABAS COAST project seeks to implement NbS to improve Flood and Coastal Erosion Risk Management (FCERM), a NBS should not only be designed for one specific function; rather, it should focus on improving multiple functions/ ecosystem services in the system in which it will be incorporated.

In the MANABAS COAST project, multiple test-sites, dubbed as pilots, are working on implementing NbS to improve FCERM, where pilots are in different phases when it comes to the implementation. Pilots need a common understanding on NbS to communicate effectively and to improve the mainstreaming process together. A knowledge and evidence foundation needs to be build (further) to ensure that NBS are chosen over traditional methods. Achieving this in combination with incorporation into the processes and policies of key actors will lead to the next step forward. MANABAS COAST is one of the many EU-projects looking to further experiment and learn about NbS ([MANABAS COAST](#) | [Interreg North Sea](#)).

Implementation, Mindset & Transition thinking

Wickenberg et al. (2021):

“Nature-based solutions can help tackle climate change and advance (urban) sustainability by using nature to deliver social, ecological and economic benefits. However, their success largely depend on implementation for which several barriers exist.”

When it comes to the implementation, which can further progress into mainstreaming, barriers need to be removed and/or overcome. NbS are different to the standard presently, as they allow for natural dynamics; while their man-made brothers/sisters do not follow that line. In order to understand the hiccups with implementation, first the barriers need to be described and understood.

NbS are tested in the form of pilots, experiments in a specific location, where they can grow and be implemented at multiple locations and eventually become the new standard.

From pilot to mainstreaming

NbS barriers have been overcome in many instances, and while NbS are already implemented at various sites in the form of many different pilots, it has not (yet) become a form that is mainstreamed and used as standard. When it comes to mainstreaming, Frantzeskaki & McPhearson (2021) identify three common knowledge frontiers that need to be overcome: strengthening global evidence for the efficacy of NbS; bridging the disciplinary silos; ensuring co-production and sharing knowledge globally.

Han & Kuhlicke (2021) discuss two very important socio-political aspects that hinder the mainstreaming when it comes to NBS implementation; Populism and Inadequate public participation. While these barriers could be overcome through the socio-political climate, informing people and emphasizing their importance and role, this does not mean that this will happen. People tend to have many different opinions based on background, education, history and other factors that leads to them accepting or not accepting claims that NBS implementation is the best solution to a problem. To create public support, information about NbS and their implementation needs to be shared with the public in such a way that it is understandable.

Institutional embedding, fitting the NbS into the (local) norms and context, is crucial when it comes to effective implementation and going from one local pilot to becoming the standard. Nationally Determined Contributions (NDCs) – national climate plans under the Paris agreement, have no standard templates as of yet, such as NbS incorporation. This makes it very hard to mainstream NbS in Europe and elsewhere in the world as NDCs tend to differ a lot per nation (Châles et al. 2023). However, there are examples of frameworks and theories, which can be incorporated alongside the NDCs. The United Nations Development Program (UNDP) for instance developed a climate toolbox in which a framework for NbS implementation regarding the NDCs can be found. This framework aims to help governments incorporating NbS in their NDC (NDC partnership, n.d.)

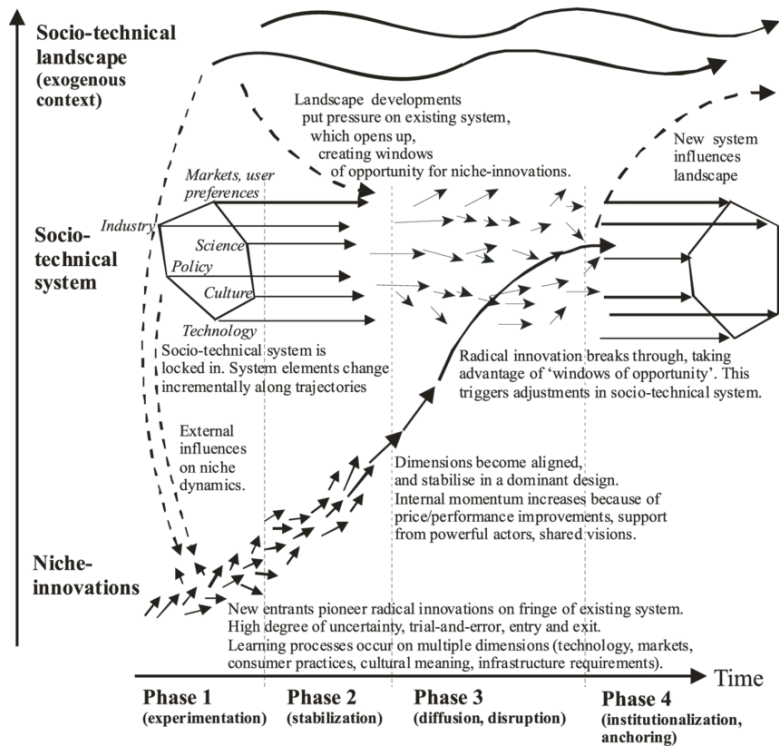


Figure 6: Multi-level perspective on socio-technical transitions (Geels, 2019; adapted from Geels, 2002). Pilots and niche innovations leading to cracks in the socio-technical regime, applicable to NbS.

Implementation barriers

Sarabi et al. (2020) describe the main barriers to NbS implementation, divided into 5 categories in this report, as the following:

Table 1: Barriers of NbS implementation (Sarabi et al. 2020)

| Influenced by people their vision/ mindset | Management barriers | Lack of knowledge | Financial barriers | Spatial planning / property rights |
|--|---|--|---|---------------------------------------|
| Lack of political will and long-term commitment (B1) | Misalignments between short-term plans and long-term goals (B6) | Lack of skilled knowledge brokers and training programs (B9) | Lack of available financial resources (B12) | Property ownership complexities (B14) |
| Lack of sense of urgency among policymakers (B2) | Lack of supportive policy and legal frameworks (B7) | Functionality and performance uncertainties (B10) | Lack of financial incentives (B13) | Space constraints (B15) |
| Lack of public awareness and support (B3) | Lack of design standards and guidelines for maintenance and monitoring (B8) | Perceived high cost (B11) | | |
| Risk aversion and resistance to change (B4) | | | | |
| Silo mentality (B5) | | | | |

Different barriers need different solutions, however, when integrated a lot of barriers could be tackled simultaneously.

In the Natural and Nature Based Features (NNBF) guidelines, a project development framework is drawn up, preventing and overcoming barriers that might rise before, during and after the implementation of a NbS.

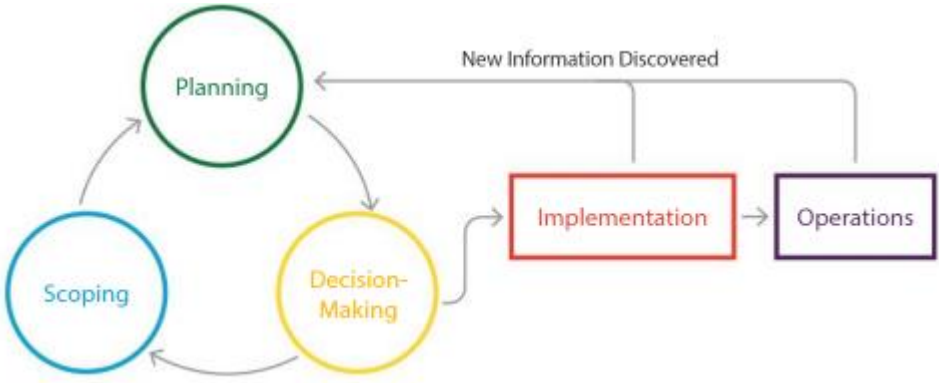


Figure 7: Different phases of the project development framework for a NbS (Bridges et al. 2021)

The scoping, planning and decision-making phases can help in overcoming a lot of the barriers mentioned before, as long as the different elements are taken into account that can lead to barrier-formation.

Scoping can provide crucial insights into the political and long-term commitment (B1), during the scoping and planning urgency can be created towards policymakers (B2), public awareness can be created (B3) and risk aversion towards change can be dismantled (B4). During the scoping, research can be done on the political and legal frameworks (B7) to ensure that the NBS fits in the political/legal landscape. Also, design standards can be drawn up and guidelines for maintenance and monitoring (long-term planning) should be acknowledged (B8). When a lack of knowledge is present this can be identified and knowledge can be gained during the scoping and decision-making (B9), while knowledge accumulation will also happen throughout implementation. When scoping has been done extensively, functionality and performance uncertainties (B10) should not happen. Sudden outliers of high perceived costs (B11) will not happen, just as financial resources (B12) and incentives (B13) not being available. Space constraints (B15) need to be considered during the scoping to overcome possible limitations.

Bringing together different organizations and stakeholders can overcome silo mentality (B5) during the decision-making/ implementation phase. Alignment of short and long-term planning (B6) can be achieved and needs to be integrated during the phases. Property ownership complexities (B14) can both be worked out in the scoping and planning phase, as well as in the decision-making and implementation phase.

By walking through all the possible barriers and identifying whether they need to be tackled can effectively lead to (easier) implementation of NBS.

Enabler system

Another way of looking at overcoming the barriers identified is through the enablers identified by Ecoshape ([Enablers - EcoShape](#)). The enablers are meant to aid in the creation, implementation and upscaling of NBS. The enablers aid at the start and during the process of NBS implementation, by helping identifying key considerations. The six enablers are interlinked and work together (Ecoshape, 2023).



Figure 8: Enablers and their system taken from Ecoshape (2023)

Within the MANABAS COAST project, enablers are used to indicate performance and the trajectory of the pilots where NbS are implemented and how this can lead to upscaling and mainstreaming. In the project, enablers are mapped on three (partly overlapping) systems, being the natural, social and governance system.

The enablers and project development framework in the NNBF guidelines together can provide a good foundation for getting NbS from the ground and effectively working towards implementation.

While some of the barriers need to be overcome by changes in the political/financial paradigm, many barriers are created due to a certain mindset, focusing on single problems and solutions instead of a system-based approach (highlighted in barrier 5, silo mentality). A broader shift in mindset can influence the political, socio-economic and natural landscape in favor of NbS.

Nature-based Thinking (NBT)

Budding-Polo Ballinas et al. (2022): “Thinking and working with nature instead of fighting natural processes is promising but requires a change in mindset.”

Mercado et al. (2023) defined the next step when it comes to this mindset, being nature-based thinking (NBT). As a response to the intensifying crises in the ecological, social and economic field, both in urgency and scale, questions are raised regarding the implementation of NbS. They argue that the NbS concept may mobilise nature as a resource that can be exploited, while rather we should see it as a partner with whom we should be working together. NbS should not be used in ways of a greenwashing strategy, being used solely as an eco-modernist that disregards wider drivers and necessities of systematic change (Melanidis & Hagerman, 2022). Anthropogenic and instrumental conceptions are regarded when it comes to the effective implementation of NBS. As an example, the technocratic solutionism, thinking that technological advancements will solve all problems, which is commonly happening in urban development, is mentioned. Currently this way of thought is the dominating narrative, leaving no room for (radical) different perspectives (such as those focusing on the human-nature relations).

Part of NBT is overcoming barriers by integrated and transdisciplinary coordination across and beyond scale (Wickenberg et al., 2021). The system-based approach is part of NBT, as it strives for maximization of co-benefits and avoiding trade-offs happening due to mismatches on (governmental) scale. In addition, NBT calls out for other forms of knowledge regarding nature and the relation between society and nature. More and different forms need to be incorporated for the change to be brought into the system. Indigenous, traditional and ancestral knowledge should not be disregarded, but fostered, for a better understanding of nature and its contextual relation to society. These types of knowledge need to be imbedded in the governmental and knowledge system. As can be seen, the natural, social and governance system need to be approached holistically instead of isolated.

NBT is a mindset that sees nature and the social system as everlasting connected, functioning across and between different sectors, levels and disciplines implementing NBS rather than grey-conventional infrastructure. Part of the mindset is the educating for change supporting the desired transformation (Mercado et al., 2023) (Figure 3). Education and capacity building need to incorporate nature-based thinking to further make people aware of nature being integral to the living and build world.

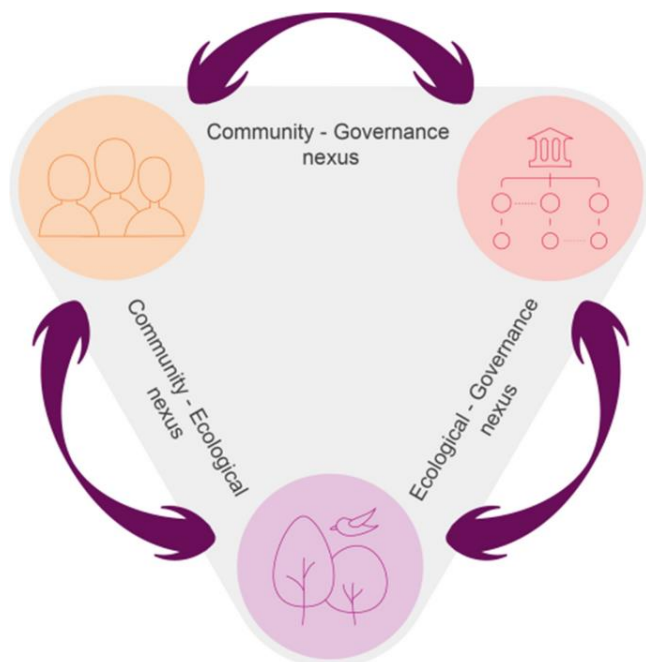


Figure 9: NBT and the three relations (Mercado et al. (2023), adopted from Randrup et al. (2020)).

NBT envisions relations between the ecological, governance and social (phrased as community) system. The ecological system revolves around securing space for nature beyond just their services and solutions, taking into account natural processes and their functioning, fluctuations and dynamics. The governance system revolves around the institutions, both formally and informally, managing and recognizing the need to break silo's and work on building connections between government and local institutions from planning to designing, building and managing. The social system, or community as called by Mercado et al. (2023), is made up by the communities living with/by nature. The social system needs to be reconnected with nature on multiple levels, being physically, spiritually, and emotionally.

NBT seeks out a shift from an individual to a systemic approach, by looking into the three systems and the interlinkages between them. A balance between the three nexus is ought to be found. When digging into the interaction between nature and governance, the value of NbS within the governmental framework needs to be assessed. The ultimate question to be answered regarding the social-nature interaction, is how we can integrate community-centred ways of relating to nature into current development and management. When looking at the final nexus, the interaction between the social and governmental system Mercado et al. (2023) suggest that new practices, technologies and approaches are needed to co-create long-term visions and transformation on the socio-ecological system. However, there are many examples showing that we are on the right track, such as the example of the Ems (figure 2).

NBT has the potential to form a deeper integration of nature in planning and management, expanding on current ways of thought when it comes to NBS. This can be achieved by developing a cultural-structural change based on innovative human-nature relation (perspectives) accompanied by different/new

governance paradigms, allowing for collaboration between different sectors and engagement of stakeholders independent from organizational structures. NBT has many similarities with the enablers of Ecoshape, showing the necessity of the three systems (natural, social and governance) to work together.

Palomo et al. (2021) further elaborate on the change in mindset by assessing transformative change with NBS. To assess the ability of NbS to deliver transformative change, elements that may catalyze transformative change are used as input for a framework. Four elements were identified as the main elements providing a base for NbS to catalyze transformative change: Nature's values, knowledge types, community engagement and nature management practices. In **Figure 10** other elements are shown encompassing NbS and their impact on transformative change.

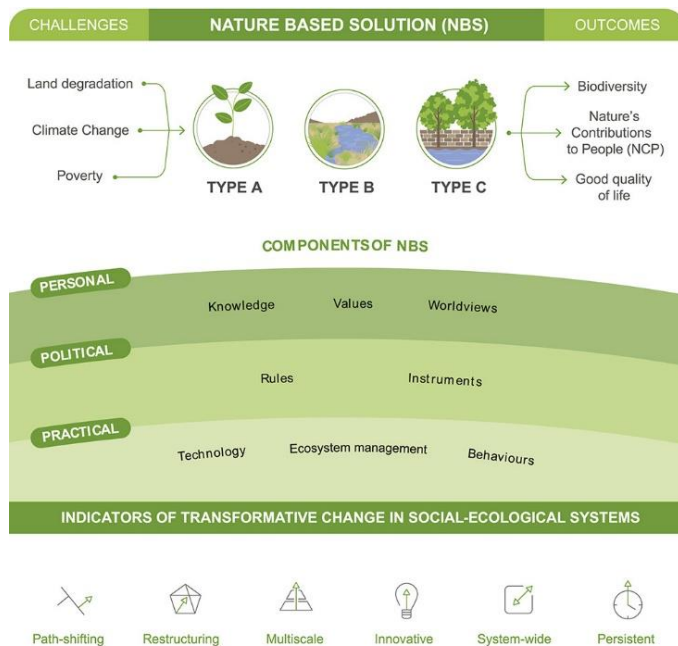


Figure 10: Framework providing the key components for assessing the effectiveness of NbS and allowing for tackling long-term transformative change processes (NbS types; A = Conserving biodiversity and preventing degradation, B = Local and Indigenous Peoples, biodiversity-friendly development, C = Climate adaptation and disaster risk reduction) (Palomo et al. 2021)

ISBAM

Klingman & Cohen (2004): 'The generic approach focuses on the characteristic course, rather than on the unique response and the unique needs of each individual'.

Ecoshape and Rijkswaterstaat introduced the 'Integrated System-Based Asset Management (ISBAM)' in 2021, another way of a changed mindset looking into highest value instead of lowest cost. Both NBT and ISBAM fit in the broader sense of prosperity, described by the Dutch Government as the prosperity of quality-of-life present day as well as the amount of damage this does to the prosperity of future generations (CBS, n.d.). NbS are a long-term commitment instead of a quick win, benefitting future generations.

ISBAM describes the managing of assets in their broader geographical and socio-economic context, looking into the functioning of the system in its vicinity, rather as a whole than in its individual functions.

As stated on their website, ISBAS drives for a transition from single-minded focus and low-cost asset management to a system-based, highest value approach. To do this, ISBAM focuses on 'establishing' and 'mainstreaming' their principles. ISBAM strives for connecting different elements and programs, collecting the experiences and using this as input and fuel for acceleration and standardization.

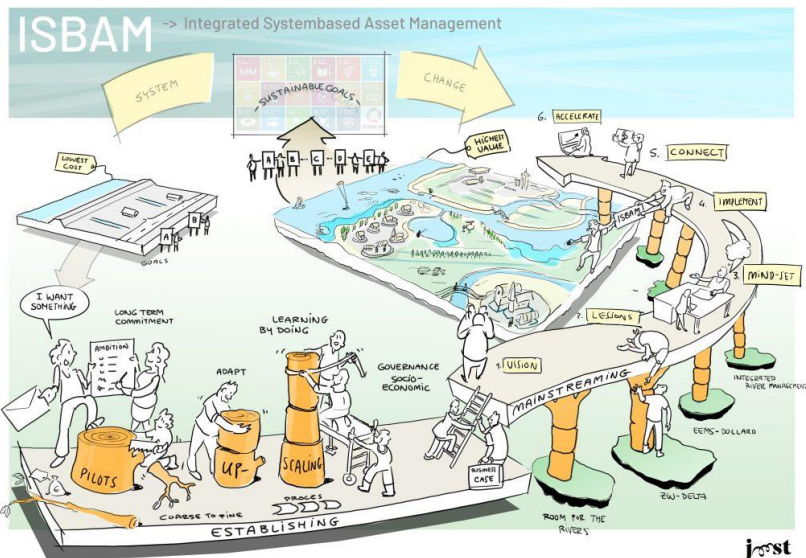


Figure 11: ISBAM visualized (Ecoshape, 2022)

ISBAM integrates the mainstreaming component as they mention the learning by doing concept. Multiple pilots can help in bridging knowledge silo's, solving different problems quicker as there is more varied experience and helps in creating a broader driven vision.

ISBAM mentions a so-called spark that is needed to trigger asset managers and decision makers. The spark is needed to ensure that they are aware of the impacts their decisions have on long-term performance on the system and that lock-in situations should be prevented. This spark can trigger policy makers to realise the sense of urgency and do something to change the current trajectory. When looking into implementation of a NbS, work on finding this spark and triggering the (identified) right people/ organizations.

ISBAM finalizes with the critical feature that, as mentioned at the end of the implementation barriers, a different mindset is needed for integrated asset management, where it is all about working with nature instead of against nature. The (natural) system and its dynamics need to be embraced, bridging the gap between the social and natural system. The natural system and social system need to be interwoven, understood and embraced instead of working in opposite directions. ISBAM brings together most barriers mentioned in this report, providing solutions to overcome the identified barriers.

For more information on ISBAM, see: <https://www.ecoshape.org/en/get-started/white-paper-integrated-system-based-asset-management/>

Nathan Crilly further elaborates on the way of mindset that needs to shift by integrating three ways of thinking; design thinking, entrepreneurial thinking and design thinking (figure 12). Combining the three can lead to actualization of change needed to further mainstream NBS.

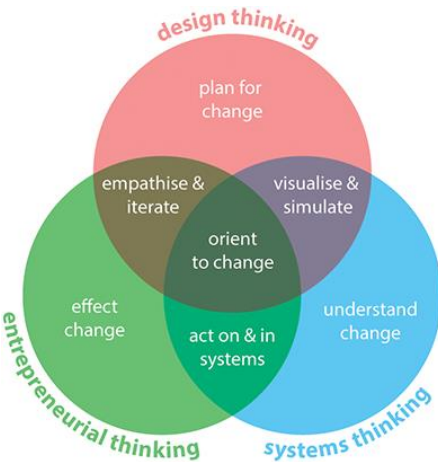


Figure 12: Combining systems thinking, entrepreneurial thinking and design thinking (Crilly, 2024).

Conclusions

To further mainstream NbS, grasping the essentials of NbS is crucial for an effective implementation. NbS vary due to many factors, showing the need to present professionals with handles to understand their fundamentals. Professionals equipped with the fundamentals are provided with knowledge to work out achievable strategies for NbS implementation.

NbS can be characterized by multifunctionality, aligned with the natural system, while simultaneously addressing socio-economic needs and providing benefits. NbS need to be integrated in the system, not being used as a solution to one specific problem. Providing a better understanding of NbS and their advantages and disadvantages, helps in effectively implementing them and considering them as a viable option instead of thinking in the conventional ways. Accompanying a better understanding, a change in mindset plays a pivotal role for (willingness towards) implementation of NbS. Those with power to implement a change need to adopt a new mindset, moving away from the conventional ways.

While NbS and their implementation face many barriers, as described in this report, there are many ways to overcome these barriers. Scoping, planning and decision-making based on facts can overcome barriers stated in this report, when given thought.

Besides lowering barriers, governments and policy makers need to look into ways of removing barriers. Governments at all levels play a big role in spatial planning, both when it comes to the present as well as the future. NbS provide many benefits, which governments and decision-makers need to take into account instead of looking away due to their lack of knowledge or fear of uncertainty.

The way forward

Gaining knowledge and understanding NbS fundamentals helps in identifying how and with whom to implement an NbS. Following this up with learning by doing, gaining further knowledge and experience, fostering collaboration with different stakeholders provides the next pillar for NBS implementation. Improving capacity building to expand the NbS implementation factor and removing barriers helps working towards NbS mainstreaming.

To move forward with NbS, bringing the natural and socio-economic system to one big integrated system, a new way of thinking but also a new way of working and improving what is already being done needs to be the focus. Changes in mindset need to be cemented and used as foundation for work done in the physical environment. Providing (local) knowledge, both through doing and teaching, can help bridge barriers. Scalability will increase with more pilots sharing their insights, which can be used to draw lessons on either replicability or context-specificity to create replication guides as to further upscale NbS.

The natural system can foster with further knowledge on the system, assessing the state and dynamics of the system and using this for integration with the social and governance system.

The social system can grow by stakeholder involvement, which needs to continue its growth, stimulating collaboration. To further pave the way, stakeholders and policy makers need to find each other in the form of workshops and meetings. Financial mechanisms, such as funds and grants, need to be placed into the system to further stimulate the use of NBS and to overcome barriers raised by the long-term benefits of NBS compared to other short-term beneficial projects.

Policy needs to be aligned with goals for both the natural and social system, leaving little space for hindering the implementation of NbS. Supportive legislation needs to be drafted, while critically reviewing current policies.

At last, international cooperation is needed for the upscaling and mainstreaming of NbS, as climate change will lead to changes in the three mentioned systems not on a local scale but on the global scale and the natural system does not regard borders in ways the social and governance system might. NbS need to be indifferent to political changes, letting (economical) benefits speak for itself but also with projects such as MANABAS COAST.

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