

Benefit Accounting of Nature-Based Solutions for Watersheds Landscape Assessment

AUGUST 2020



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Support

The work was generously supported by the following CEO Water Mandate endorsing companies: Asia Pulp and Paper, Danone S.A. and the Microsoft Corporation.

Acknowledgements

The following reviewers provided input on the content and structure of the document:

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The work was edited by Brendan McLaughlin and designed by Dana Beigel.

Recommended Citation

Tien Shiao, Cora Kammeyer, Gregg Brill, Laura Feinstein, Michael Matosich, Kari Vigerstol and Carla Müller-Zantop (2020). Business Case for Nature-Based Solutions: Landscape Assessment. United Nations Global Compact CEO Water Mandate and Pacific Institute. Oakland, California. www.ceowatermandate.org/nbs/landscape

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ISBN: 978-1-940148-09-0

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Executive Summary

This landscape assessment is the outcome of Phase 1 of a tri-phased project and was designed to inform the path forward for engaging the private sector to invest in nature-based solutions (NBS). A literature review was undertaken to understand the contemporary thinking around NBS and identify key opportunities and challenges faced by decision makers, practitioners and researchers. Interviews conducted with representatives of businesses, civil society and academia who have already implemented NBS projects or are looking to do so yielded qualitative responses to complement or contrast with the findings from the literature review.

The key interview findings suggest that businesses are motivated to implement NBS for a variety of reasons. Context is important for determining which NBS are most relevant for a business. Businesses are interested in maximizing the benefits of their investments, and most investments occur (or should occur) at the watershed scale. To further improve our understanding of current corporate investment in NBS, the project team also conducted a review of NBS case studies from the private sector. These case studies included a range of NBS project types across differing geographies, habitat types and industry sectors. As a result of the literature and case study reviews and interviews, this landscape assessment aims to:

1. Explore the concept, definitions and classifications of NBS;
2. Identify barriers to scaling NBS;
3. Review available frameworks or methods for evaluating, measuring and demonstrating the value of NBS benefits; and
4. Examine opportunities to scale NBS.

Methods, frameworks, initiatives and programs utilize a variety of approaches to improve the implementation and increase the efficacy of NBS that align with business motivations or which address local societal challenges. This landscape assessment identifies a variety of mechanisms to scale NBS implementation, and categorizes them based on their approach. Interviewees mentioned shortcomings in many of these currently available approaches and mechanisms. Several approaches are being implemented by the private sector, including those that create partnerships around NBS or that align with public policy. Fewer approaches are being implemented to build the capacity of stakeholders to design and implement NBS projects or to identify the multiple benefits of NBS.

Systematically measuring the physical outputs provided by NBS and translating them into outcomes and longer-term impacts (e.g. protection of a critical instream ecosystem) can establish a more comprehensive understanding of multiple NBS benefits. Measuring NBS outputs can be partitioned into two primary activities:

1. Benefit identification: the process of establishing the full range of NBS benefit types; and
2. Benefit accounting: the quantitative or qualitative estimation of each benefit.

The majority of the approaches focused on benefit accounting consider carbon and water, which suggests that businesses have mainly focused on accounting for a narrow subset of possible NBS co-benefits. In addition to benefits, all NBS projects also have potential for trade-offs (negative or unintended impacts) that should also be considered when identifying and accounting for the benefits of NBS. Several approaches to categorize benefits and trade-offs, as well the possible metrics and associated biophysical models, are explored in this landscape assessment. Notably, there is not yet consensus among existing approaches on how to properly account for the NBS benefits accrued over time.

While benefit identification and accounting enables NBS actors to calculate the output, outcome and/or impact of a project in terms of environmental, social and environmental benefits, benefit valuation goes a step further to assign a monetary value to that benefit. These valuation methods can demonstrate the return on investment and provide market incentives. There are fewer approaches used by the private sector to value NBS compared to accounting for benefits and scaling NBS. This is partly because legal and policy frameworks, as well as markets, need to be in place to properly value NBS.

While considerable progress has been made in benefit identification, accounting and valuation, and momentum in NBS investments by the private sector is increasing, there are technical, governance and financial challenges and barriers which limit implementation at scale. To address these challenges and barriers, partnerships between the public and the private sector are increasingly needed in order to demonstrate economic, social and environmental opportunities and create incentives for the large-scale application of NBS. These partnerships will need more developed legal and policy frameworks to add incentives and reduce transaction costs; transparency to build acceptance and incentivize investments; and mechanisms to monitor and evaluate project outcomes. Regulations and policies, incentive-based instruments and improved methods for benefit identification and accounting must operate together and must be integrated into multi-stakeholder management and governance collaborations to support the restoration, management and protection of natural ecosystems, such as watersheds. However, a first step is to provide more clarity and a systematic and standardized approach to account for the multiple benefits of NBS for watersheds in a way that builds the business case for investing in and implementing NBS at scale.

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Introduction

Human impacts, such as land-use change and unsustainable water use, are degrading ecosystem and water catchment functions, leading to reduced ability to sequester carbon, retain water, maintain biodiversity and healthy waterways, promote social well-being, and sustain agricultural productivity. Climate change is exacerbating these impacts by shifting hydrological regimes and increasing the recurrence and severity of natural disasters.

Nature-based solutions¹ (NBS) offer a mechanism to improve degraded ecosystems, leading to improved water quality and quantity, carbon sequestration and biodiversity, among many others benefits (Global Commission on Adaptation and World Resources Institute, 2019). In addition, NBS can also be used to manage floods, droughts and extreme weather events in ways that are more flexible and resilient than many traditionally engineered solutions (Browder et al., 2019).

A wide variety of organizations are interested in implementing NBS to provide environmental and societal benefits. In particular, businesses are starting to recognize the value of NBS for mitigation, adaptation and enhanced resilience. Many businesses have already invested in NBS through a variety of projects, such as treatment wetlands for reducing pollution discharge to waterways, preserving forests by committing to deforestation-free supply chains, or integrating NBS into long-term sustainability plans.

While NBS can substantially improve ecosystems, it currently remains underutilized, partly because of a lack of frameworks and tools for identifying the benefits and for monetizing the full scope of co-benefits provided by NBS projects. Many investors are not aware of the full range of potential benefits of NBS, from both from an ecosystem perspective and a business perspective. Additionally, under-investment in NBS is due to a variety of factors, including weak project pipelines, whereby projects are developed and

¹ Nature-based Solutions (NBS) are defined by the IUCN (2016) as “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits”.

implemented over too short a period (NBS are generally long-term projects), a perceived lack of “bankable projects”², or where the true values of NBS are not adequately calculated to support decision making.

Markets and investors often do not value social and environmental benefits of NBS that can improve the health and wellbeing of communities and the environment, such as improved air quality or reduced greenhouse gas (GHG) emissions. As a result, it can be difficult to comprehensively allocate a financial value to implementing NBS, which translates into significant challenges in obtaining financing for these solutions. Financing for NBS projects has typically relied on grants and government funding, which has, to date, been limited to certain NBS, geographic locations or specific challenges (e.g. improving water quality). Further investment from the private sector is needed to meet the shortfall from grant and government funding.

There is also a lack of public and private sector policy and governance frameworks to promote or incentivize NBS investments, without which it becomes increasingly difficult to justify or support investment in NBS. Additionally, the path dependency of organizational decision making (i.e. initial decisions or company positions can increasingly restrain present and future choices) can significantly influence the appetite for and ability of the public and private sectors to consider investing in NBS. An overhaul of public and private sector policy and governance frameworks may be needed to move NBS into mainstream decision making and implementation.

While businesses are interested in implementing NBS, there is still a gap in project funding. The private sector is advocating for more financing for NBS, or for policies that facilitate investments in NBS, but oftentimes the private sector needs a clear business case. The multiple benefits provided by NPS have not been sufficiently tracked. Common metrics for the multiple benefits derived from NBS will allow businesses, investors, the public sector and others to consistently estimate and communicate the water and carbon benefits associated with NBS, and broader co-benefits. This would strengthen the business case because common metrics are critical to demonstrate investment returns, mainstream finance mechanisms, and support effective policy reform.

² Has sufficient collateral, future cash flow, and high probability of success, to be acceptable to institutional lenders for financing.



Background

The background to this landscape assessment discusses the current definitions of NBS, the types of NBS across different interventions and habitats, as well as the objectives of the assessment.

DEFINITION OF NATURE-BASED SOLUTIONS

The concept of NBS arose out of an increasing recognition of the fundamental role ecosystems play in addressing some of society's biggest challenges, including enhancing water security, reducing risk of natural disasters, avoiding degradation of natural ecosystems, and mitigating or adapting to the impacts of climate change. The definition of NBS has evolved over time, with a greater emphasis on taking a proactive role in supporting NBS versus being a passive beneficiary of the societal benefits ecosystems provide.

There are three main definitions of NBS. While they are very broad, which can lead to confusion, the definitions all allude to the need to consider the multiple benefits provided by NBS.

1. European Commission

“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.”

This definition for NBS focuses on “solutions that are inspired and supported by nature.” This definition also considers environmental benefits beyond biodiversity, as well as including social and economic benefits. Furthermore, this definition addresses cost-effectiveness and broader resilience considerations (Maes and Jacobs, 2015).

2. European Parliament

“Actions inspired by, supported by or copied from nature that aim to help societies address a variety of environmental, social and economic challenges in sustainable ways. Most nature-based solutions do not have a single objective, but aim to bring multiple co-benefits.”

This definition is similar to the European Union's definition, although it articulates that “actions inspired, supported by or copied from nature” should be considered. It does not state that purely natural solutions are relevant. This definition does not address cost-effectiveness or elements of resilience or sustainability (European Parliament, 2017).

3. International Union for Conservation of Nature

“Actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges, effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.”

Currently, the NBS definition proffered by the International Union for Conservation of Nature (IUCN) is the most widely accepted and used. It was developed from a global perspective considering all types of ecosystems but focuses primarily on the protection and management of natural ecosystems. The IUCN definition promotes “actions to protect, sustainably manage, and restore natural or modified ecosystems,” as opposed to interventions that are inspired by nature, and focuses on addressing societal challenges to meet human well-being and biodiversity priorities. A major criticism levelled at this definition is that it could include anything that provides a benefit to nature, whereas the other definitions explicitly mention solutions or actions that are inspired by and supported by nature. Other social, economic and environmental factors are not listed in this definition (Cohen-Shacham et al., 2019).

This project will adopt the IUCN definition (2016) as this is the most established and referenced. It is simple and adequately broad. The IUCN is considered a leader in the field of NBS and is in the process of reviewing the NBS definition, principles and standard. This project can therefore align with later versions of the NBS definition, principles and standard as these become available. This definition will support the development of the project scope, specify a list of principles and parameters, and develop a list of interventions across multiple habitat types (e.g. wetland restoration) for businesses to quantify stacked benefits.

TYPES OF NATURE-BASED SOLUTIONS

Despite their great potential, the spread and standardization of NBS in both the scientific literature and in practice is limited. This may be due to the lack of a comprehensive, concise and easy-to-use classification scheme for NBS. As with the ecosystem services classification by the Millennium Ecosystem Assessment, a simple and commonly-accepted NBS classification would support the transfer of the concept into adaptation and risk mitigation plans (Martin et al., 2020). This single classification system has yet to be created and, as a result, there are numerous approaches for classifying NBS (Appendix A).

For this project, three criteria were used to develop a classification scheme to better understand the types of NBS. The categories were *mutually exclusive* to the extent possible, although NBS is inherently cross-cutting, and can be part of several categories. The categories were *comprehensive* to cover a broad range of NBS, and *outcomes should not be part of the classification scheme* because the objective was to understand the different benefits resulting from NBS.

Based on these criteria, this project developed a classification scheme that is closely based on the Nature-based Solutions Evidence Platform (University of Oxford, 2019) and the IUCN Habitats Classification Scheme (IUCN, 2012). For this project, NBS are classified across two dimensions: *Intervention* and *Habitat*. This resulted in 24 unique NBS categories (Figure 1).

FIGURE 1. Classification scheme for nature-based solutions

		INTERVENTION TYPE			
		Restoration	Protection	Management	Created
HABITAT TYPE	Forest				
	Savanna, Shrubland, Grassland and Desert				
	Marine, Estuaries and Intertidal				
	Wetland				
	Artificial and Introduced				
	Terrestrial Agriculture				



Intervention Types

An intervention type is defined as “Actions... involving management, restoration or protection of biodiversity, ecosystems, or ecosystem services, or involving the creation or management of artificial ecosystems” (University of Oxford, 2019). In this project, four major types of intervention are considered and defined below:

- 1. Restoration:** An active or passive intervention that involves returning degraded, damaged, or destroyed ecosystems to a pre-disturbance state. Considered synonymous with reclamation, reforestation, rehabilitation, revegetation and reconstruction.
- 2. Management:** Natural resource management approaches other than restoration or protection. Examples include ecosystem-based fire management and actions characterized as forestry or forest management.
- 3. Protection:** An intervention that prevents (or greatly limits) overexploitation of natural resources to achieve the long-term conservation of nature with associated ecosystem services and cultural values.
- 4. Created:** Interventions involving the establishment, protection or management of artificial ecosystems, i.e. an ecosystem or habitat framed by the authors as a non-natural system or if it cannot be determined if the intervention involves a natural habitat. This includes non-natural tree stands created or managed to address climatic impacts, artificial grasslands, created wetlands (not restored), etc. This also includes most agricultural, fisheries and livestock farming approaches, including pastoralism.³

Habitat Types

Habitats are areas occupied by living organisms. Several systems for classifying ecosystems were reviewed. The habitat scheme developed by the IUCN⁴ (IUCN, 2012) was selected for this project. This approach designates sixteen major habitat types using a combination of biogeography, latitudinal zonation, and depth in marine systems. Each of the sixteen categories are broken into multiple sub-categories.

For the purposes of this review paper, 16 of the IUCN’s categories were further amalgamated into seven groupings. For example, the five marine ecosystems were grouped under one heading. Cities, gardens, aquaculture pens and most other human-dominated ecosystem types are grouped as “Artificial and Introduced.” Agricultural lands are classified by IUCN as subcategories of “Artificial-Terrestrial.” However, given how commonly NBS are employed on agricultural lands, this project considered agriculture as its own habitat category. Figure 2 defines the seven habitat groupings that will apply to this project.

³ The University of Oxford (2019) also included two blended categories: “Combination” and “Mixed Created/Non-Created.” These blended categories were not considered in this project.

⁴ The classification system presented by the IUCN is under review. It is very difficult to develop a single classification system for habitat types, given the wide variety in global ecosystems, and the gradual transitions between habitat types. Nonetheless, the IUCN’s approach is widely used and is applicable in the vast majority of circumstances.

FIGURE 2. Habitat types and groupings



Forest:
A continuous stand of trees.



Savanna, shrubland, grassland, and desert:
These are areas characterized by a grass understory, and in some cases (shrubland and savanna) are accompanied by a sparse herbaceous or woody overstory.



Marine, Estuaries and Intertidal:
All areas under ocean influence. Includes ocean floor, open ocean, estuaries (where rivers and oceans mix), intertidal zone (the land between high and low tide), and coastal supratidal ecosystems (area directly above the limit of high tide). It includes saltwater wetlands.



Wetlands (Inland):
Freshwater areas, either home to submerged vegetation (such as ponds or river channels), or areas with waterlogged soil and emergent vegetation (such as riparian habitat and marshes).



Rocky and Subterranean:
Rocky inland areas with little or no vegetation such as cliffs and mountain peaks, and caves created by the weathering of rock.



Artificial and Introduced:
Artificial habitats are heavily altered by humans and dominated by cultivated or invasive species, such as gardens, urban areas, aquaculture and weedy degraded habitat.



Terrestrial Agriculture:
Land areas used by humans for food, fuel and fiber production.

More detailed definitions can be found on the IUCN Habitats Classification Scheme (IUCN, 2012). Appendix B provides a crosswalk depicting how IUCN habitat categories were assigned to the seven groupings employed in this assessment.



Objective of the Landscape Assessment

This project explores developing a guide and standardized method to estimate the multiple benefits of NBS for watersheds in order to support and strengthen the case for businesses to invest in NBS. The primary audience is the private sector, due to the current and proposed NBS investments already being made by businesses. However, the project outputs are applicable to a broad range of stakeholders, including the public sector, academia and civil society groups. Multi-stakeholder applicability will build the business case and support scaling up of NBS implementation globally.

Through desktop research and interviews with stakeholders, this landscape assessment examines whether a standardized method to estimate stacked benefits of NBS strengthens the business case for NBS.

Specifically, the landscape assessment aims to:

1. Explore the concept and definitions of NBS;
2. Identify barriers to scaling NBS;
3. Review available frameworks or methods for evaluating, measuring and demonstrating the value of NBS benefits; and
4. Examine opportunities to scale NBS.

FINDINGS FROM PRIVATE SECTOR INTERVIEWS

To meet the objectives of this study, interviews (Appendix C) were conducted with individuals from the private sector, civil society and academia who have explored the opportunity to invest in NBS or who already implement NBS projects. The seventeen interviews provided a representative sample of the sectors which have invested in NBS projects globally. The key findings from interviews suggest that:

1. Companies are motivated to implement NBS for a variety of reasons;
2. Context is important for determining which NBS is most relevant for the company;
3. Companies are interested in maximizing the benefits of their investments; and
4. Most investments occur (or should occur) at the watershed scale.

These findings are further elaborated on in the sections to follow.

MOTIVATIONS FOR IMPLEMENTING NATURE-BASED SOLUTIONS

Motivations for implementing NBS vary between businesses based on their economic sector, geographic location and environmental and socioeconomic priorities/challenges. For example, some businesses implemented NBS to meet their sustainability targets, including water, carbon, biodiversity and social targets. Others implemented NBS to address water-related regulatory, reputational or physical risks, such as floods and droughts. Businesses also implemented NBS due to their ability to deliver multiple benefits which increase over time, because NBS can be more cost-effective than conventional engineered solutions, and because they provide a greater return on investment.

NBS approaches that were most frequently cited by interviewees included:

- 1 Forest restoration or protection for water quantity and quality benefits (53%)**
- 2 Wetland restoration, management or protection for water quantity and quality improvements (35%)**
- 3 Artificial and introduced habitats to address flooding (29%)**
- 4 River and lakes restoration, management or protection (24%)**

Interviewees also cited agricultural best management practices (BMPs) to improve water quality, groundwater protection, coastal and desert management.

Interview responses revealed that most businesses prioritize action in the watersheds in which they operate, source goods and services from, or from which they obtain water. Businesses also suggested that when identifying the scale at which they would like to take action (e.g. within the boundaries of their property, city-level, etc.), a company may want to consider a broader landscape scale, generally the watershed level. Most businesses prefer to work in the basin(s) where they have the potential to experience risks and/or affect the communities in which they operate. However, there are some cases when businesses look outside of that basin if it is proving difficult to provide sustainable opportunities. Businesses look to identify specific projects they can support, but also aim to work with other stakeholders rather than trying to address all of the challenges in a particular basin alone.

To address the gap between company action on project and basin outcomes, a few businesses saw value in engaging at a larger scale when they can contribute to a fund collectively and receive mutual benefits, including:

- Positive, local public relations;
- Political capital from participating;
- Market access;
- Reduced transaction costs;
- Reduced energy costs; and
- Wealth and health improvements where they operate, which can increase market potential.

NGOs working on NBS projects globally suggest that businesses often look to invest collectively to maximize benefits and leverage broader engagement, or in low-risk opportunities that are aligned with a company's internal sustainability, environmental and social goals. This allows the company to maximize returns on NBS investments by meeting multiple goals through benefit stacking, especially as carbon benefits are becoming more attractive for company participation.

The summary of findings from the stakeholder interviews is presented in Appendix D.

CHALLENGES AND BARRIERS TO IMPLEMENTING NATURE-BASED SOLUTIONS

While the momentum in private-sector NBS investments is increasing, there are additional technical, governance and financial challenges and barriers that companies face when implementing these projects. This section provides additional information on these challenges and barriers raised during the interviews. They are reported using the six main barriers in the development of NBS described by Sarabi et al. (2019) as a guiding framework.

1. Uncertainty regarding implementation process and effectiveness of the solutions

NBS are often innovative and revolve around complex socio-ecological systems, which makes them difficult to monitor and evaluate. As a result, businesses are uncertain if these solutions will provide results which address their specific priorities/challenges. Furthermore, the positive consequences of NBS are largely published for academic audiences and findings are not widely disseminated, which limits public awareness and acceptance. Additionally, while the financial benefits of traditional gray infrastructure projects have previously been quantified, there are limited frameworks and tools to quantify, value and monetize the benefits of NBS and other green solutions.

2. Inadequate financial resources

Historically, the majority of financial resources for NBS projects has typically come from grants and government funding, which have, to date, been limited to certain NBS, geographic locations or to meet specific challenges. Some businesses have been reluctant to invest in NBS due to the high levels of uncertainty regarding implementation

“ While the momentum in private-sector NBS investments is increasing, there are additional technical, governance and financial challenges and barriers that companies face when implementing these projects. ”



processes and effectiveness of the solutions. Some businesses may demand short-term returns on large investments, yet many of the benefits of NBS only become apparent over the longer term. This return on investment model may not be favorable when compared to other options which may yield similar benefits in the short term, yet fail to produce further benefits over the medium to long terms.

Cases exist that can serve as investment templates to convince private investors to invest in NBS. A report on “Conservation Finance: an untapped investment opportunity” (Suisse et al., 2016) discusses scalability as one of the main obstacles to greater investment in natural capital. Most projects lack replicability beyond a \$5 million threshold, which increases transaction costs. The lack of large-scale investment opportunities is another limiting factor for banks and other intermediaries to invest in green solutions, according to The Nature Conservancy’s “Investing in Nature” report (TNC, 2019). This especially discourages large mainstream investors from considering NBS. Within the public sector, many municipalities lack the necessary human and financial resources to consider NBS investments at scale, or are unable to invest in NBS due to policy constraints or social and economic priorities (e.g. social housing projects which limit public finance available for NBS).

3. Path dependency of organizational decision making

Many stakeholders are confident in making investments in gray infrastructure solutions based on demonstrated results over time. This has informed their decision making for current and future behavior. Changing this behavior or mindset from gray to green (i.e. towards NBS investment) can be a significant challenge. Some decision makers or practitioners within businesses may be risk averse toward the uncertainty posed by NBS, and may err on the side of tried and tested solutions. Technical challenges also arise when businesses lack internal hydrogeological expertise or capacity to understand watershed management and the implications of NBS projects. Finally, since NBS projects are usually long term, staff turnover compounds the issue of finding or retaining technical expertise.

4. Inadequate regulations

There is still little representation of NBS in global policy. In some cases, ecosystem protection is not fully included in regulation. In cases where regulations and policies do consider NBS as options for investment in addressing certain challenges, some public and private sector actors may prefer to invest in conventional status-quo gray infrastructure options. Most regulations and policies across the public and private sectors have been developed to prioritize traditional gray infrastructure solutions (e.g. to build water security, dams have been built to store water, rather than investing in landscape management and alien plant removal to enhance groundwater supplies which could support long-term water security). There are oftentimes limited public sector incentives for adopting NBS or prioritizing investments in green solutions. Additionally, businesses may sometimes be legislatively restricted from owning or leasing land, which prevents them from having full discretion over how to manage their land and implement NBS. A common policy for many utilities is that they cannot spend public money outside of the municipality, which restricts them from investing in NBS in the watersheds where they source their water, even if it is a cost-effective solution to secure their water supply. These kinds of policies are slowly changing in some places around the world, but they are still not the norm in most countries.

5. Limited land and time availability

NBS generally require more space and time to achieve the same benefits as conventional gray infrastructure solutions. As space is scarce and expensive in some regions, especially the inner parts of urban areas, the implementation of NBS is challenging. Regarding time availability, local actors often have short-term agendas (e.g. political periods of five years or less), but NBS benefits most often become visible in the medium to long terms.

6. Institutional fragmentation

The people or organizations responsible for funding and implementing NBS are distributed across multiple departments and agencies working within their own mandates. Therefore, it is often a challenge to define strategies for NBS and implement these in a coordinated manner. Beyond the intra-institutional level, challenges also stem from the absence of multi-stakeholder governance (e.g. a sustainable water basin can't be achieved by one company practicing water stewardship in isolation). Success requires that all water users simultaneously promote stewardship under an effective water governance structure, which aligns interests under an agreed water-basin management plan.



Current State of Play

This section reviews the approaches to scaling NBS, benefit accounting initiative for NBS, as well as valuation initiatives for NBS.

REVIEW OF APPROACHES TO SCALE NATURE-BASED SOLUTIONS

Methods, frameworks, initiatives and programs utilize a variety of approaches to improve the implementation and increase the efficacy of NBS that address local societal challenges. This report identifies several mechanisms (i.e., frameworks, initiatives and programs) to scale NBS implementation and categorized them based on their general approach, including:

- Funding
- Tools
- Public Policy
- Awareness
- Science
- Partnerships
- Capacity Building

For example, the Asian Development Bank has earmarked funding for NBS projects because competing interests can make it difficult for developing countries to devote funding to NBS projects. Tools such as *A Green Guide* developed by the World Wide Fund for Nature (WWF) and United States Agency for International Development's (USAID) can provide step-by-step frameworks and public policy recommendations for city officials implementing NBS projects, while simultaneously spreading awareness about the effectiveness of NBS in the hopes of fostering further adoption. Additionally, foundations such as the Doris Duke Charitable Foundation can support research to build the science around NBS, establish innovative partnerships that combine resources and skills, and build capacity of those implementing NBS projects—all of which can increase the likelihood that NBS projects are effectively designed and successfully implemented.

SUMMARY OF FRAMEWORKS

Table 1 (elaborated in Appendix E) provides a high-level overview of the frameworks, initiatives and programs for scaling NBS, as well as their approach to scaling. Some mechanisms, such as Doris Duke Charitable Foundation's Natural Climate Solutions Special Initiative, are more comprehensive because they incorporate several different approaches into their scaling approach. In this instance, the initiative encompasses finance, public policy, awareness, building the science, creating partnerships and capacity building. Other mechanisms, such as Social Finance's Pay for Success program, focus on a smaller subset of approaches, such as finance and creating partnerships.

The private sector is well aware of NBS opportunities, encouraged through partnerships or alignment with public policy, and have begun to invest in NBS projects. However, businesses appear to struggle when building the capacity to mainstream the adoption of NBS, possibly due to the lack of in-house skills, capacity, or concrete tools to deploy NBS solutions at a greater scale. These challenges indicate that in order to promote the adoption of NBS solutions at scale, there are additional needs: (1) building capacity of stakeholders (both internally and externally), and (2) developing straightforward tools that make it simple for stakeholders to identify the multiple benefits and take action to implement NBS.



TABLE 1. Example organizations and mechanisms and the approaches taken to scaling nature-based solutions

Organization/Mechanism	Approach to Scale						
	Funding	Tools	Public Policy	Awareness	Data and Information	Partnerships	Capacity
WWF + USAID A Green Guide		●	●	●			
WWF + Global Mangrove Alliance						●	●
Youth4Nature				●			●
University of Oxford Nature-Based Solutions Initiative	●		●	●	●		●
Asian Development Bank Case Studies from the Greater Mekong Subregion	●					●	
Conservation International + MIT				●	●	●	
Doris Duke Charitable Foundation	●		●	●	●	●	●
Organisation for Economic Co-operation and Development's Roundtable on Financing Water	●		●			●	
Convention on Biological Diversity			●		●		
Conservation International + BHP Framework		●				●	●
UN-REDD+		●	●	●		●	●
UN Development Program	●		●			●	●
World Business Council for Sustainable Development + IUCN		●		●			
Wildlife Conservation Society	●		●	●	●	●	●
World Resources Institute			●	●	●		
Nature Insurance Value: Assessment and Demonstration	●		●		●		
Verra Verified Carbon Standard		●				●	
Quantified Ventures	●						
Social Finance	●					●	
Section 404 of the Clean Water Act			●				
Electric Power Research Institute				●	●		
Coalition for Private Investment in Conservation	●					●	
Wisconsin Wetland Credits Bill	●		●				
Ecosystem Services Market Consortium	●	●			●	●	
Pacific Institute's Multi-Benefit Framework*		●	●	●			
Ocean Health Index*		●		●	●		
Conservation International's Landscape Assessment Framework*	●	●	●	●	●		
Freshwater Health Index*		●	●	●	●		
Organisation for Economic Co-operation and Development's Social Investment Framework*	●	●					
Greenhouse Gas Protocol*		●				●	
Natural Capital Coalition*			●	●		●	
Dow + TNC's ESII Tool*	●	●		●			
Total	15	13	16	16	12	15	8

*Mechanisms that were mentioned in interviews and/or were not discovered during desktop research

Interviewees mentioned several shortcomings in currently available mechanisms, including:

- Lack of mapping that connects categories/actions to issues or items that businesses really value (i.e. a framework that helps build the business case for NBS investment)
- Lack of ability to monitor progress on meeting company goals
- Lack of flexibility to weight indicators relevant to a specific company

REVIEW OF BENEFIT ACCOUNTING INITIATIVES FOR NATURE-BASED SOLUTIONS

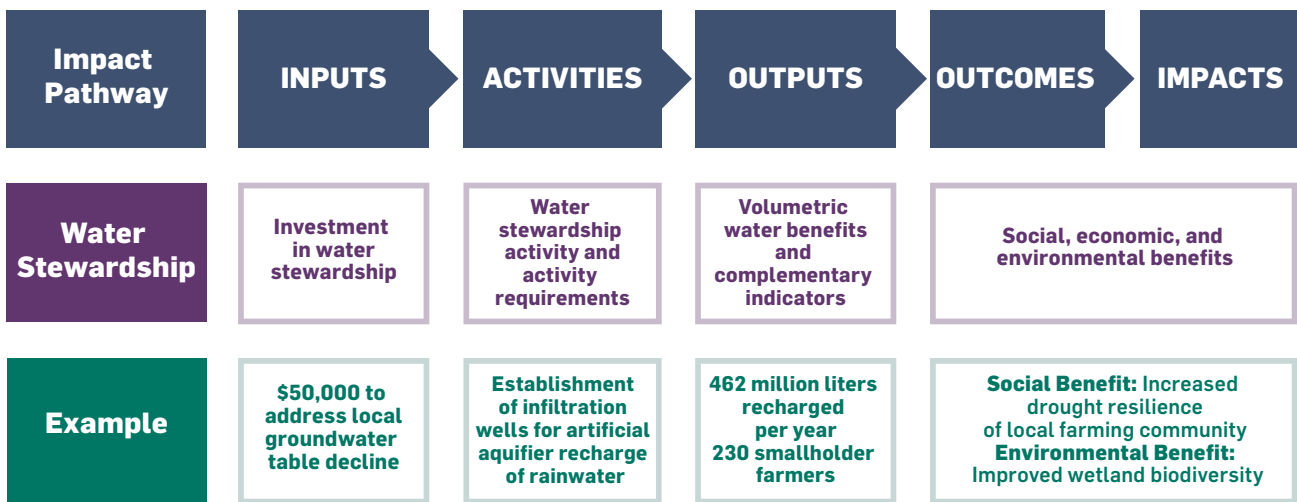
It has been discussed that NBS can provide multiple benefits and co-benefits. Systematically measuring the physical outputs provided by NBS (e.g. increased river flow, reduced pollutant loads) and translating these into outcomes and longer-term impacts (e.g. protection of a critical instream ecosystem) can establish a more comprehensive understanding of the multiple benefits associated with NBS. It can also be helpful to distinguish between outputs, outcomes and impacts to avoid double counting the estimated benefits. The World Resources Institute’s (WRI) Volumetric Water Benefit Accounting is one example of an outcome-oriented approach (Figure 3) to account for the volumetric water benefits of investments in water stewardship activities, although water stewardship activities are broadly applicable to other NBS and classes of benefits (Reig et al., 2019).

The multiple benefits of NBS can be partitioned into two primary activities:

1. Benefit identification: the process of establishing the full range of the types of benefits associated with NBS; and
2. Benefit accounting: the quantitative or qualitative estimation of each benefit.

All NBS projects have the potential for trade-offs (negative or unintended impacts) that should also be considered when assessing the benefits of NBS.

FIGURE 3. Water stewardship activity impact pathway



There are also several ways to categorize benefits and trade-offs. The Pacific Institute's *Multi-Benefit Framework* categorizes the benefits into themes, with economics considered as a transversal indicator across all five themes (Diringer et al., 2020). The themes are:

- Water (e.g. water supply, water quality and flood control);
- Energy (e.g. energy use for water, energy for heating and cooling);
- Land and environment (e.g. habitat and biodiversity, air quality and GHG emissions or reductions);
- People and community (e.g. local economy and jobs, health and well-being, recreation and community resilience); and
- Risk and resilience (e.g. physical, reputational and regulatory risk, and system resilience).

FIGURE 4. Water management strategy themes from Pacific Institute's Multi-Benefit Framework



SUMMARY OF INITIATIVES TO ESTIMATE THE BENEFITS FROM NATURE-BASED SOLUTIONS

There are numerous approaches that can be used to estimate the benefits from NBS, including frameworks, methodologies and tools/models (Table 2). The content and level of development of these approaches varies widely. Some approaches were developed to evaluate a single benefit category (e.g. the World Resources Institute's (WRI) and the World Business Council for Sustainable Development's (WBCSD) Greenhouse Gas Protocol) while others take a more holistic approach, incorporating a broader range of benefits (e.g., Restore the Earth Foundation's EcoMetrics).

Similar to the interviews, the majority of the approaches in Table 2 primarily focused on accounting for carbon (24) (under Land and Environment) and water (18), which suggests that businesses have, to date, mainly focused on accounting for a narrow subset of possible NBS co-benefits. This may indicate that businesses tend to think only about one benefit at a time, and that there are a lot of unaccounted benefits from NBS projects. There are examples of methods that evaluate co-benefits, including Restore the Earth Foundation's EcoMetrics and Dow's ESII tool, but they have not yet been widely used to measure and track benefits from NBS.

Metrics are used to estimate benefits and trade-offs. Metrics are selected based on data availability, whether it is measuring outputs, impacts and/or outcomes, and/ or the spatial scale of the NBS project (e.g., urban green stormwater infrastructure vs forest restoration). For this reason, we provide a relatively basic overview of potential metrics in Table 3 (with further detail in Appendix F).

In addition, the temporal scale of these benefits is often considered in a singular way. For example, carbon accounting currently treats carbon stock gains and losses over time as equal, but temporal considerations may be important. An emission now may cause more damage than an emission in the future, and a removal now may have more benefits than a removal in the future. This is also an issue in water accounting. Although some methods address this issue, there is a lack of consensus on how to properly discount or inflate for time. There are several approaches for identifying biodiversity benefits, although none of the businesses were explicit in mentioning these.

Biophysical models are used to calculate metrics when there is sufficient data. These models are commonly used to assess how land-use change can affect the provision of water-related benefits, such as sediment reduction and increased water supply. Examples include the Soil Water Assessment Tool (Texas A&M University and USDA Agricultural Research Service) and Water Evaluation Planning System (Stockholm Environment Institute). The Volumetric Water Benefit Accounting framework (World Resources Institute), utilizes these models. Many benefit approaches used to analyze ecosystem services also translate these services into economic values, such as the Organisation for Economic Co-operation and Development's (OECD) methods for biodiversity valuation and the WRI Green-Gray Assessment.

TABLE 2. Benefit identification and/or accounting approaches which produce outputs, outcomes or impacts across a variety of categories

Approaches	Benefit identification/ accounting	Output/ Outcome/ Impact	Water	Energy	Land and Environment	People and Community	Risk and Resilience	Financial
Aligning Biodiversity Measures for Business	Accounting	Output			●			
Restore the Earth Foundation EcoMetrics	Accounting	Outcome	●		●	●	●	●
American Carbon Registry	Accounting	Output			●			
Autocase Methodologies	Accounting	Output	●	●	●	●	●	●
Center for Neighborhood Technology National Green Values Calculator	Accounting	Output	●	●	●			●
Conservation International Biodiversity Impacts and Benefits Framework	Accounting	Output			●			
Conservation International Landscape Assessment Framework	Identification	Outcome	●		●	●	●	●
Dow and The Nature Conservancy ESII Tool	Accounting	Output	●	●	●	●		●
EKLIPSE Impact Assessment Framework	Accounting	Impact	●		●	●	●	●
Global Biodiversity Framework	Accounting	Outcome			●			
Greenhouse Gas Protocol	Accounting	Output			●	●		
Freshwater Health Index	Identification	Outcome	●		●	●		
Green Infrastructure Leadership Exchange Co-Benefit Valuation Tool	Accounting	Output	●		●			●
InVEST	Accounting	Outcome	●		●			●
i-TREE	Accounting	Output	●	●	●			●
Landscape Architecture Foundation's Landscape Performance System	Accounting	Output	●		●	●	●	
Michigan State and Electric Power Research Institute's Methodology for Quantifying Nitrous Oxide (N2O) Emissions Reductions from Reduced Use of Nitrogen Fertilizer on Agricultural Crops	Accounting	Output			●			
Ocean Health Index	Identification	Output	●		●	●	●	●
Organisation for Economic Co-operation and Development Methods Biodiversity Valuation	Accounting	Output			●			●
Organisation for Economic Co-operation and Development Social Investment Framework	Identification	Impact						●
Pacific Institute's Multi-Benefit Framework	Identification	Output	●	●	●	●	●	●
Soil Water Assessment Tool	Accounting	Output	●					
Sustainable Rice Platform	Identification	Outcome	●		●	●	●	
The Clean Energy Regulator's Carbon Accounting for Avoided Clearing of Native Growth	Accounting				●			
Verra Verified Carbon Standard	Accounting	Output			●			
Volumetric Water Benefit Accounting	Accounting	Output	●				●	
Water Evaluation and Planning System	Accounting	Output	●					
WRI Green-Gray Assessment	Identification	Outcome	●		●		●	●
Total			18	5	24	11	10	14

TABLE 3. Benefits of water management and potential metrics for measuring benefits from existing water accounting and evaluation methods

Themes	Benefits	Potential Metrics
Water Supply	Water supply	Water volume recharged; total volume captured
	Water demand	Reduced total demand; reduced potable demand; reduced withdrawal
Flooding	Large-scale flood risk	Avoided flood damage to properties; reduced insurance premiums; avoided safety costs
	Nuisance structural flooding	Avoided costs for damages; reduction in 100-year flood height
Water Quality	Surface and coastal water quality	Pollutant reductions (e.g., nitrogen, phosphorous, fecal coliform); avoided cost of water treatment
	Groundwater quality	Reduced energy for groundwater treatment or pumping
	Drinking water quality	Improved human health; avoided additional treatment costs
Energy	Energy embedded in water	Energy intensity of water (kWh equivalents per volume); total energy used for water (kWh equivalents)
	Energy production potential	Energy provided by flows to downstream (kWh)
	Energy for operations	Energy for heating and cooling buildings and other facility systems (kWh)
Environment	Reduced urban heat island effect	Reduced average air temperature; reduced peak air temperatures; energy consumption or cost
	In-stream flows	Improved flow regime; reduced erosive events
	Habitat availability and quality	Total restored habitat; available habitat for species; valuation of ecosystem services
	Carbon footprint	GHG emissions (total and reductions); carbon sequestration
	Air quality	Oxygen creation; reduction in airborne pollutants
	Soil health	Soil carbon; plant productivity
People and Community	Local economy	Impact to property values; local jobs; gentrification
	Access to high-quality jobs	Total job availability by job type; wage benefits
	Health and well-being	Health metrics (e.g., blood pressure, public safety); mental and emotional health metrics (e.g., improvement in mood, workplace satisfaction, quality of life)
	Education	Adult or child eco-literacy; time spent outside of school absorbing knowledge
	Recreation	Distance to recreation; total recreation time
	Household affordability	Total utility bills; relationship between bills and disposable income
Risk and Resilience	Resilience to natural hazards	Risks of natural hazards and ability to respond (e.g., insufficient water supply, flood, or earthquakes)
	Financial risks	Debt coverage; reserves; risk of stranded assets
	Reputation	Public perception; engagement from public
	Regulatory risk	Ability to meet current regulation; ability to meet future regulation

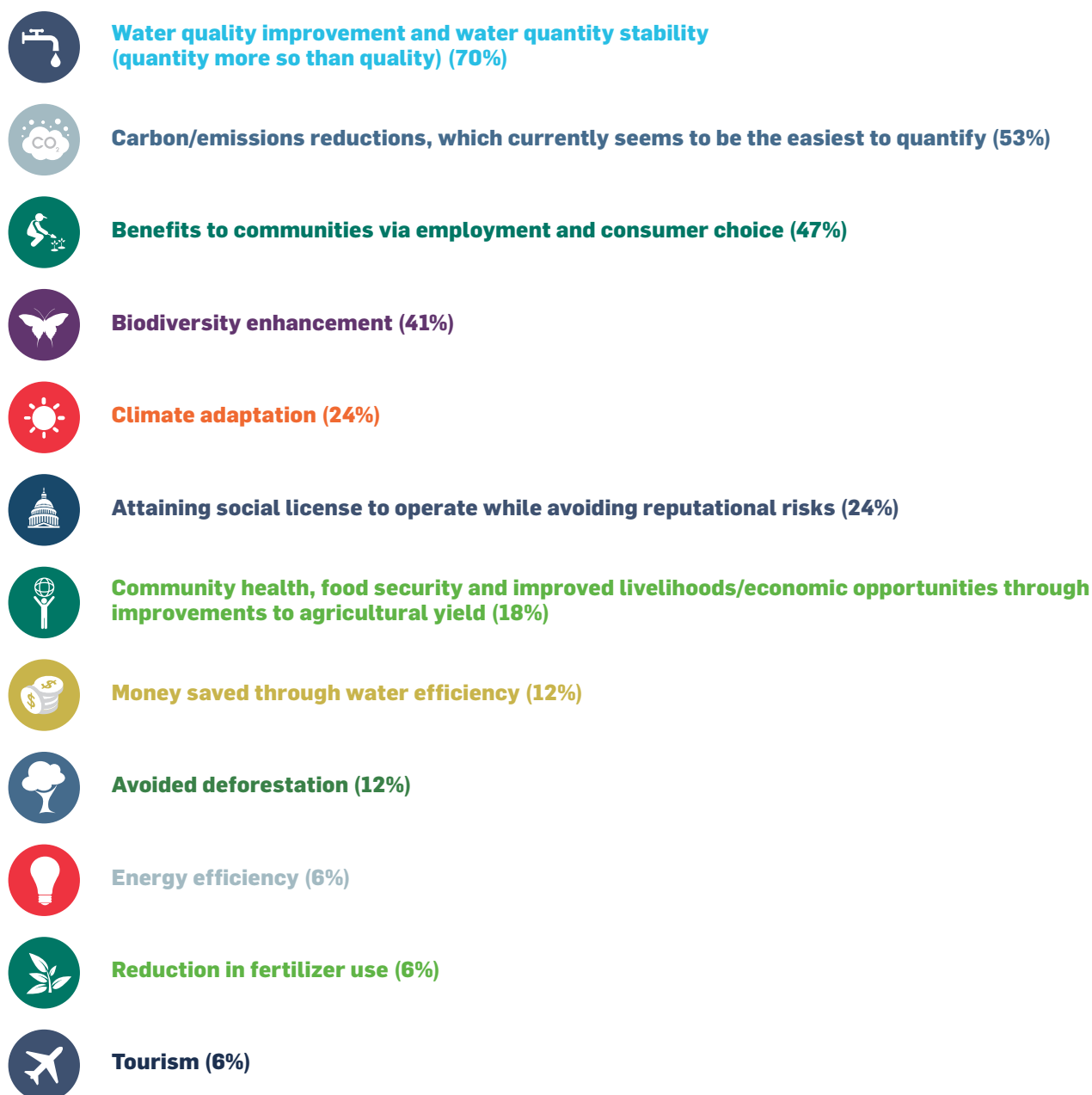
Table adapted from the Pacific Institute's Multi-Benefit Framework (Diringer et al., 2020).

From the interviews conducted, many methods and models were acknowledged, but the most commonly identified were:

- Volumetric Water Benefit Accounting
- Restore the Earth Foundation's EcoMetrics methodology
- InVest
- Michigan State University & Electric Power Research Institute's (EPRI) Nitrous Oxide Calculator

During the interviews, businesses stated several types of benefits that they hope to quantify. Again, interest varies across sectors and locations, but there is growing interest in stacked credits (Figure 5).

FIGURE 5. Benefits of nature-based solutions that businesses want to quantify (in order of priority)



What businesses find useful and/or hope to see in these methods are that they:

- Are verifiable (to a certain extent) and logical
- Are science-based and/or developed by credible parties
- Use global principles through which methods can be approved for different purposes (e.g. Greenhouse Gas Protocol)
- Quantify both the total and marginal benefit of solutions, as well as the costs (marginal cost curves can help rank different approaches)
- Address monitoring and evaluation

Some issues that interviewees raised with these methods include:

1	Tools can be counter-productive if they do not encourage businesses to go beyond simply offsetting
2	Water issues are much more complex and require more action to solve
3	Some tools only show directionality (InVest)
4	Methods do not address irrigation issues
5	Verification needs a higher level of independence
6	Methods do not measure and specifically quantify impacts and realization of benefits
7	Methods do not provide real examples of how to use them
8	Governance issues are not mentioned
9	There is no equity among stacked benefits (water should be on par with carbon)
10	A review of initiatives to value benefits from NBS is missing

REVIEW OF VALUATION INITIATIVES FOR NATURE-BASED SOLUTIONS

While benefit accounting enables NBS actors to calculate the output, outcome and/or impact of a project in terms of environmental, social and environmental benefits, benefit valuation goes a step further to assign a monetary value to that benefit. In other words, valuation methods for NBS demonstrate the return on investment (ROI) and provide market incentives. This valuation is essential to continue to build a business case for investing in NBS.

Valuing NBS can lead to markets including water trading, water quality trading, carbon trading and payment for ecosystem services. These incentive-based instruments for improving water quality, increasing freshwater quantity and/or reducing carbon emissions using financial means, directly or indirectly, reduce health or environmental risks. To determine which instrument to use, it is important to understand the stakeholders' (e.g. communities, companies, governments) water goals. Furthermore, these instruments are

often only operated with effective regulations. Governments can leverage public policies and instruments to send the appropriate signals to markets and facilitate the path towards investing in green infrastructure (The Rockefeller Foundation and Pacific Institute, 2015).

MECHANISMS AND MARKETS FOR VALUING NATURE-BASED SOLUTIONS

To better understand how to value the benefits associated with NBS, a desktop review was conducted to identify the initiatives for NBS valuation (Table 4 and Appendix G), including:

FIGURE 6. Categories of initiatives for valuation of nature-based solutions



Financial enablers as a mechanism to support funding (4)



Tools to quantify or qualify NBS-related impacts or results (3)



Market-based initiatives where there is a price, economic value or cost to define market trading (4)



Non-market initiatives where there are additional incentives for action without a quantifiable value, such as mandatory reporting (1)



Partnerships to bring together stakeholders (2)



Platforms to enable or facilitate stakeholder engagement (2)

Certain initiatives in Table 4, such as bonds and credit-trading systems, provide access to funding for projects that are normally difficult to finance. Also, there are a few benefit valuation tools such as WRI's Financial Calculator that estimate the costs and benefits, including the ROI, of natural infrastructure interventions designed to enhance aquifer recharge. Other initiatives, such as carbon markets and emission trading schemes, have contributed to improving the financial viability of NBS.

TABLE 4. Initiatives to value nature-based solutions

Initiatives	Financial Enabler	Tool	Market-Based	Non-Market Based	Partnership	Platform
Beverage Industry Environmental Roundtable (BIER) True Cost of Water Toolkit		●				
Carbon credit trading			●			
CPIC working group	●				●	●
Ecolab Water Risk Monetizer		●				
Environmental impact bonds	●					
Ecosystem Services Market Consortium					●	●
Green bonds	●					
Green water credits	●		●			
Mandatory carbon reporting				●		
Water quality trading			●			
World Resources Institute Financial Calculator		●				
Water trading			●			
Total	4	3	4	1	2	2

Those interviewed identified only a few methods to value the benefits from NBS, such as Ecolab's True Cost of Water. There were no stand-out responses regarding what is working well among the initiatives for demonstrating ROI and market incentives. This suggests that businesses may lack awareness of valuation methods and/or more work is needed to develop more valuation methods that take into account the costs and benefits of NBS.

Interviewees highlighted the importance of water markets (both quantity and quality) to buy and sell access entitlements or to pay for actions that reduce water impacts. However, interviewees' assumptions are that current initiatives lack cost-benefit approaches for different stakeholders, including accounting for potential risks. In addition, they have criticized the lack of transparency, which is required to build trust and may support the increase in investments in NBS projects.



Going forward, partnerships between the public and private sectors are increasingly needed in order to demonstrate ROI and create incentives for the large-scale application of NBS. These partnerships will need (1) more developed legal and policy frameworks to add incentives and reduce transaction costs; (2) transparency to build acceptance and incentivize investments; and (3) monitoring and evaluation methods to ensure initiatives are successful and deliver desired outcomes. Regulations and policies, incentive-based instruments and improved methods for benefit accounting must operate together and must be integrated into a multi-stakeholder management effort of natural ecosystems such as watersheds (The Rockefeller Foundation and Pacific Institute, 2015).



Conclusion and Recommendations

This landscape assessment was designed to inform the path forward for engaging the private sector in NBS investments. A literature review was undertaken to understand the contemporary thinking around NBS and identify key opportunities and challenges faced by decision makers, practitioners and researchers. Interviews conducted with businesses who have already implemented NBS projects or are looking to do so yielded qualitative responses to complement or contrast the findings from the literature review. The key findings provide a path forward for future phases of this project, and lay the foundation for benefit accounting of NBS for watersheds.

ENGAGING THE PRIVATE SECTOR IN NATURE-BASED SOLUTIONS

NBS provide an opportunity to invest in nature and provide benefits to water, carbon and biodiversity, as well as social and economic systems, while improving resilience to future extreme events and natural disasters. Municipalities and other public sector actors currently face significant barriers to investing in NBS, giving businesses the opportunity to invest in and scale the implementation of NBS to benefit their own businesses, communities and environments worldwide. Encouraging additional private investment in NBS will require defining economic opportunities and evaluating the true value of environmental benefits and trade-offs.

Increasing the number of investments and successful implementation of NBS will require long-term collaborative efforts among multiple stakeholders. This will involve designing or adopting appropriate financial tools that should also be complemented by country-specific policies, regulatory mechanisms and project development protocols tailored to green investments. Governments can leverage public policies and instruments to send the appropriate signals to markets and facilitate the path towards investing in NBS. Examples from successful initiatives, such as carbon markets and emission trading schemes, have improved the financial viability of green projects. This should be leveraged to bolster further investment in NBS.

KEY LEARNINGS FROM THIS LANDSCAPE ASSESSMENT

There is a growing interest in NBS due to their ability to cost-effectively address multiple challenges facing environmental, social and economic systems. However, the potential to implement NBS at scale remains largely untapped. This is due to multiple factors.

- First, decision makers and practitioners lack a full understanding of the financial instruments to incentivize large-scale investment in NBS;
- Second, both the literature review and interviews undertaken for this assessment show that there is a lack of consensus on the definitions, principles and methodological approaches surrounding NBS, despite much work done in these areas;
- Third, the operationalization of NBS lacks clarity and often requires actors to work together in ways which may not be supported by current policies. Without this clarity, the ability to leverage financial incentives, or the ease of operationalizing implementation of NBS, the pace of scaling NBS will likely remain the same, or even slow over time;
- Fourth, individual and societal behavior change is required and must be encouraged to deconstruct path dependency on gray infrastructure solutions, with more consideration given to NBS to address key societal challenges;
- Finally, government agencies, municipalities and businesses do not have the necessary tools to systematically assess the full impact of NBS, including the costs and trade-offs, and the financial value of their multiple benefits.

If these five issues are not remedied, we stand to lose a critical opportunity for addressing current and future needs for people and nature. This may result in further degradation of the services that nature can provide, including clean water, carbon storage, biodiversity and a suite of other benefits. While acknowledging that many of these challenges relate to the need for institutional changes, financial valuation or financial incentives to support NBS implementation, these will not be addressed in the next phase of this project. What we hope this work can accomplish is to provide more clarity and a systematic approach to accounting for the multiple benefits of NBS to watersheds in a way that builds the business case for investing in and implementing NBS at scale.

CONTINUING WORK

By clarifying the business case for NBS investment, the aim of the next phase of this project is to develop a method to estimate the stacked benefits of NBS. This project scope meets the recognized needs of the private sector, identified as one of the highest priorities to scaling NBS. To carry out the scope, a learning-by-doing approach will be adopted, supported by the expertise and experience of an expert advisory group. We will share this draft method with a wider set of actors for peer review, with the intention of creating a scientifically credible yet practical method. The process will begin with a workshop of the core working group, where a strawman approach will be developed. This approach will be tested in a learning-by-doing process on a set of private sector case studies (see Appendix H) in several regions of the world, which will be selected through a specific set of criteria. This testing will inform updates to the approach to ensure it is applicable across a full range of project types. The updated draft method will then be tested by the expert advisory group and a broader set of stakeholders through other forums, such as at international conferences and other relevant events.

This method will form part of a broader guide on benefit accounting, which will highlight the imperative for private sector investments in NBS for watersheds, articulate definitions, principles and parameters, share best practices, and present the method development process. The guide will capture how this method has been applied to real or hypothetical cases, and will discuss unique aspects, gaps and challenges to show real-world applicability. The guide and method will be disseminated widely, using the networks of the project team, expert advisory group and broader stakeholders involved in this project.

The primary audience for this project is the private sector because of its strong current and proposed investments in NBS. However, the approach is applicable to the public sector, academia, NGOs and civil society groups, since it accounts for environmental, social and economic benefits that are of high importance to all stakeholders. By ensuring broad accessibility and applicability, this method can support the ultimate goal of promoting investments in NBS globally to address many of the most pressing societal challenges we face today.





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Appendix A. Bibliography of Resources for Classification Schemes

TABLE A-1. References and reference relevance for classification scheme typology

Reference	Reference Relevance
Cohen-Shacham, Emmanuelle, Angela Andrade, James Dalton, Nigel Dudley, Mike Jones, Chetan Kumar, Stewart Maginnis, et al. (2019). Core Principles for Successfully Implementing and Upscaling Nature-Based Solutions. <i>Environmental Science & Policy</i> 98: 20–29. https://doi.org/10.1016/j.envsci.2019.04.014	This report presents the definition and principles underpinning the NBS framework, recently adopted by the International Union for Conservation of Nature, and compares it to (1) the Ecosystem Approach that was the foundation for developing the NBS definitional framework, and (2) four specific ecosystem-based approaches (forest landscape restoration, ecosystem-based adaptation, ecological restoration and protected areas) that can be considered as falling under the NBS framework.
Naturally Resilient Communities. Explore Solutions and Case Studies. Accessed January 13, 2020. http://nrcsolutions.org/strategies/#solutions	This report groups North American NBS by hazard type, solutions and case studies.
The Nature Conservancy (2017). <i>Beyond the Source</i> . https://www.nature.org/content/dam/tnc/nature/en/documents/Beyond_The_Source_Full_Report_FinalV4.pdf	This report demonstrates the potential for source water protection to provide additional benefits like climate change mitigation and adaptation, biodiversity conservation, and contributions to human health and well-being.
The Nature Conservancy, ICLEI and EcoLogic (2019). <i>Investing in Nature for European Water Security</i> . https://www.nature.org/en-us/what-we-do/our-insights/perspectives/nature-based-solutions-for-european-water-security/	This report's main objectives are to: identify the roles that NBS can play to tackle Europe's water security challenges, as part of hybrid (green-grey) water investment strategies; extract learning from on-the-ground experiences with investments in nature for water security in Europe and identify enabling conditions and barriers to scale; and formulate recommendations on what needs to be done differently to achieve scale and contribute to water security and resilience in the European Union.

Appendix B. Habitat Classification Scheme Crosswalk

TABLE B-1. Relationships between International Union for Conservation of Nature and Pacific Institute habitat categories

IUCN	Pacific Institute	Notes
Forest	Forest	
Savanna	Savanna, Shrubland, Grassland, and Desert	
Shrubland	Savanna, Shrubland, Grassland, and Desert	
Grassland	Savanna, Shrubland, Grassland, and Desert	
Desert	Savanna, Shrubland, Grassland, and Desert	
Wetlands	Wetland	
Rocky Area	Rocky and Subterranean	
Subterranean	Rocky and Subterranean	
Shallow Marine	Marine	
Open Ocean	Marine	
Ocean Floor	Marine	
Marine Intertidal	Marine	
Marine Coastal/Supratidal	Marine	
Artificial - Terrestrial		Split by subcategory
Arable Land	Terrestrial Agriculture	
Pastureland	Terrestrial Agriculture	
Plantations	Terrestrial Agriculture	
Rural Gardens	Artificial and Introduced	
Urban Areas	Artificial and Introduced	
Subtropical/Tropical Heavily Degraded Former Forest	Artificial and Introduced	
Artificial - Aquatic	Artificial and Introduced	
Introduced Vegetation	Artificial and Introduced	
Other		Eliminated as too rare to include
Unknown		Eliminated as too rare to include

Appendix C. Interview Questions and Stakeholders Interviewed

The objective of the business and stakeholder interviews is to understand parallel efforts around NBS, collaboration opportunities, and existing methods for identifying, quantifying and valuing the benefits of NBS in order to evaluate gaps and barriers.

1. What types of NBS are most applicable to the businesses (e.g., green infrastructure, wetland restoration, etc.)? Why? At what geographic scale (e.g., watershed, river basin, district, state, country)?
2. How do NBS relate to water stewardship?
3. What challenges and barriers do businesses face when implementing NBS (e.g., technical, governance, finance)?
4. What types of benefits of NBS are of interest to businesses (e.g., water quality, water quantity, carbon, biodiversity, human livelihoods, etc.)?
5. What frameworks have you used to identify the benefits of NBS (e.g., Pacific Institute's Multi-Benefit Framework)? What are the most useful? What is missing?
6. What methods can be used to account for the benefits of NBS (e.g., WRI's volumetric benefit accounting)? What is the most useful? What is missing?
7. What methods can be used to value the benefits of NBS (e.g., incentive-based instruments such as water quality trading)? What is the most useful? What is missing?
8. Can you recommend NBS case studies, especially those by the private sector?
9. Would you be interested in testing the draft accounting methods to quantify the benefits of NBS? In what geographies? What types of NBS?
10. What are the ways we might be able to collaborate?

TABLE C-1. Interviewed companies and collaborating organizations

Company	Contact	Collaborating Organization	Contact
AB InBev	Andre Fourie and Samantha Fahrbach	Blue Risk Intel	Paul Reig
Asian Pulp and Paper	Librian Angraeni (Inggi) + Neng (Nanny) Lanny Jauhari	Conservation International	Robin Abell
BHP	Erika Korosi and Anne Dekker	Electric Power Research Institute	Jessica Fox
Dow	Eunice Heath and France Guertin	Gold Standard	Owen Hewlett
Ecolab	Emilio Tenuta	International Union for Conservation of Nature	James Dalton
EN+	Alexandra Gundobina	LimnoTech	Wendy Larson
Heineken	Jan-Willem Vosmeer	Oxford University	Dustin Garrick
Microsoft	Paul Fleming	WaterAid	Ruth Romer
PepsiCo	Tara Varghese		

Appendix D. Summary of Stakeholder Interviews

OBJECTIVE

Between January and February 2020, The CEO Water Mandate and The Nature Conservancy interviewed 17 stakeholders from the private sector, NGOs and academia. By examining past efforts to scale NBS, we can incorporate proven strategies, address difficulties and identify key partnerships to best position ourselves to develop a useful methodology to quantify multiple benefits of NBS. The findings from these interviews will accompany desktop research as part of a broader landscape analysis, which will inform the development of this methodology.

SUMMARY OF FINDINGS

What types of NBS are most applicable to businesses? At what scale?

Overall, there is no consensus that some NBS solutions are more applicable than others. There was consensus that the optimal NBS solution varies widely by sector, and even within a given sector, specific types of NBS are applicable for certain locations. Bearing in mind what is locally relevant by considering the environmental, social and political context is key to choosing the right NBS; there is no one-size-fits-all NBS to deploy.

Furthermore, NBS are chosen to address a given issue, and to deliver benefits in a specific timeframe which further diversifies the pool of applicable NBS.

That being said, NBS approaches that were the most frequently cited include:

- Forest restoration or protection for water quantity and quality benefits (53%)
- Wetland restoration, management or protection for water quantity and quality improvements (35%)
- Artificial and introduced habitats to address flooding (29%)
- River and lakes restoration, management or protection (24%)

Many interviewees from organizations claimed that businesses often look to invest in low-risk opportunities that are aligned with a company's internal sustainability, environmental and social goals. This allows them to maximize returns on NBS investments by meeting multiple goals through benefit stacking, especially as carbon markets are becoming more attractive for company participation.

There is agreement among the majority of interviewees when considering the scale of action. Most businesses are prioritizing action at the watershed level. There are some cases when businesses will look outside the basin if the smaller catchment is proving difficult to provide sustainable opportunities.

Businesses look to identify specific projects which they can support and aim to work on with other stakeholders, rather than try to fix an entire basin alone.

To address the gap between company action on the project level and basin-level outcomes, a few organizations saw value for businesses to engage at a large scale when they can pay into a fund collectively and receive benefits, namely:

- Positive, local public relations
- Political capital that can be gained from participating
- Market access
- Reduced energy costs
- Wealth and health improvements where they operate, which can increase market potential

Lastly, one respondent suggested that when identifying at what scale they would like to take action, as a starting point a company may want to look at an entire city, its problem-shed and underpinning ecosystems.

What challenges and barriers do businesses face when implementing NBS?

There is a large consensus that there is a combination of technical, governance and financial challenges and barriers that businesses face when implementing NBS.

Technical challenges stem from a “culture clash” between biologists and others who are pushing for NBS, and engineers who are comfortable with continuing business-as-usual by using gray infrastructure. Moreover, businesses may not have the internal hydrogeological expertise or capacity to understand watershed management and the implications of the considered NBS projects.

Challenges also stem from the absence of governance—one company practicing water stewardship will be fruitless in achieving a more sustainable water basin without other large water users in the basin simultaneously promoting water stewardship. Even if/when businesses come together around water governance, each company has individual targets which may make it difficult to align interests and combine forces to achieve a sustainable water basin management plan.

Lastly, financial challenges are sometimes felt when a company’s sustainability team is trying to quantify the benefits of NBS to convince their finance departments of the merits of NBS. If the sustainability team fails to convey the business case and demonstrate the expected benefits of NBS, they often do not receive the necessary funding, resorting to traditional gray infrastructure instead, where financial benefits have previously been quantified. Even if a company is amicable to developing NBS, internal conflicts of interest may occur with departments such as safety, compliance, investments, etc. In certain circumstances, the land needed may be a premium which prohibits the adoption of NBS. Externally, financial constraints may be felt if low-interest finance is unavailable and/or governments provide insufficient incentives for the adoption of NBS.

Interviewees also alluded to other challenges including:

- Uncertainty: outcomes are not guaranteed and are difficult to monitor; making sure co-benefits are actualized and are making a difference can prove challenging
- Lack of clear key performance indicators (KPIs)
- Insufficient data, especially around co-benefits
- Turnover in internal staff makes views toward NBS inconsistent
- Long length of time it can take to see results from NBS is unattractive when trying to deal with urgent issues like water stress
- Learning curve associated with NBS takes time for project managers to master (for example, planting trees and making sure they survive)
- Few business cases exist for investment that can serve as templates and value co-benefits in an equal manner
- Land rights: businesses in some geographies may be governmentally restricted from owning or leasing the land, which prevents the company from having full prerogative over how to manage their land

What types of benefits of nature-based solutions are of interest to businesses?

Again, interest varies across sectors and locations, but the growing interest in stacked credits are pushing businesses to consider:

- Carbon, which currently seems to be the easiest to quantify
- Community health, food security and improved livelihoods through improvements to agricultural yield and the economic opportunities that come with improvements to agricultural yield
- Benefits to the communities via employment and consumer choice
- Climate adaptation
- Water quality improvement and water quantity stability (primarily the latter)
- Energy efficiency
- Biodiversity enhancement
- Economic benefits (\$/liter of water saved)
- Positive publicity/the emotional appeal of telling a business story that incorporates NBS is a lot more interesting than a story about gray infrastructure
- Attaining the social license to operate while avoiding reputational risks

What frameworks are used to identify NBS benefits?

Most interviewees were not aware of or currently using frameworks to identify benefits of NBS. Some expressed doubt in the applicability of a framework and feel that it is best to move away from models and standards, and focus energy on solving one issue at a time. However, some frameworks that were mentioned and/or are being used include:

- Pacific Institute's Multi-Benefit Framework
- Biodiversity Indicator Framework
- Ocean Health Index

- Landscape Assessment Framework
- Freshwater Health Index
- Social Investment Framework
- Greenhouse Gas Protocol
- Natural Capital Protocol
- Internal tools specific to a company

Interviewees mentioned several shortcomings in the current list of available frameworks:

- Lack of mapping that connects categories/actions to things businesses really value—in other words, a framework that helps build the business case around NBS
- Lack of ability to monitor progress on meeting company goals
- Lack of flexibility to weight indicators relevant to one company

What methods can be used to account for the benefits of nature-based solutions?

- Volumetric Water Benefit Accounting
- Porteus
- Social Investment Framework
- InVest
- Michigan State & EPRI's Nitrous Oxide Calculator

What businesses find useful in these frameworks, or hope to see, are that they:

- Are verifiable (to a certain extent) and logical
- Use science-based targets
- Use global principles through which methods can be approved for different purposes (Greenhouse Gas Protocol)
- Quantify both the total and marginal benefit of solutions, as well as the costs (marginal cost curves can help rank different approaches)
- Developed by credible parties (it provides comfort and assurance to adopt the methodology)

Some issues that interviewees raised with these methods include:

- Tools can be counter-productive if they do not encourage businesses to go beyond simply offsetting; water issues are much more complex and require more action to solve
- Only shows directionality (InVest)
- Methods do not address irrigation issues
- Verification needs a higher level of independence
- Methods do not measure and specifically quantify impact and realization of benefits
- Methods do not provide real examples of how to use them
- Governance issues are not mentioned
- Equity among stacked benefits (water should be on par with carbon)

What methods can be used to value the benefits of nature-based solutions?

Interviewees identified fewer methods to value the benefits, and there were no major take-away lessons regarding what is working well among the benefit-valuing methods.

A few methods mentioned include:

- Water markets (both quantity and quality) to buy and sell access entitlements
- Water valuation tools – Ecolab’s True Cost of Water and the Beverage Industry Environmental Roundtable’s (BIER) True Cost of Water Toolkit

What is missing?

- Cost-benefit approaches that can be used by different stakeholders
- Transparency to build trust and allow people to invest in schemes; without trust, people don’t believe the situation will improve
- Mitigating risk
- Monitoring of impacts through standardized approaches

CONCLUSION

Throughout our interviews, we sensed an overall excitement towards this project and its applicability to businesses’ current needs. Yet, several participants stressed the importance of being honest and setting realistic expectations when talking about the benefits that NBS can and cannot achieve.

Our discussions helped us identify potential collaborations moving forward—including representatives from companies who could participate in our advisory panel/expert advisory group or provide opportunities to pilot test our methodology. We also received suggestions for potential case studies (see below) to test our methodology with.

We noticed that businesses were particularly interested in talking with other businesses that were interviewed for this project. Many expressed interest in sharing projects, best practices and challenges they are each facing with their respective NBS projects. We hope that providing this summary document with the list of participants will initiate conversations among the participants, and we are happy to make specific connections as needed.

The interviews revealed that many businesses have a need for a methodology to accurately quantify the multiple benefits of NBS. We look forward to further collaboration among our interviewees and want to express our gratitude to each of you who took the time to provide valuable feedback.

Thank you,

Danone S.A., CEO Water Mandate and The Nature Conservancy

Appendix E. Frameworks to Scale Nature-Based Solutions

Asian Development Bank: Nature-Based Solutions for Building Resilience in Towns and Cities

This publication highlights the results of a successful partnership between the Asian Development Bank and the International Centre for Environmental Management with co-financing from the Nordic Development Fund. This was implemented through technical assistance to promote climate resilience in cities in the Greater Mekong Subregion. <https://www.cbd.int/financial/doc/adb-naturebasedsolutions2016.pdf>

Clean Water Act Section 404

This statute establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the United States regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation (e.g., certain farming and forestry activities).

<https://www.epa.gov/cwa-404/permit-program-under-cwa-section-404>

Coalition for Private Investment in Conservation: Green Infrastructure for Watershed Management Working Group

The Coalition for Private Investment in Conservation (CPIC) aims to develop financial vehicles to attract private capital to projects and businesses that contribute to restoration of wetlands and rivers. The working group will develop financial structure blueprints for projects and businesses that involve or restore green infrastructure resulting in better stormwater management for cities, drought reduction, flood protection, improvement of water quality and/or better access and supply for drinking water, irrigation, industry and energy. The working group is led by WWF.

<http://cpicfinance.com/blueprints/green-infrastructure-for-watershed-management/>

Convention on Biological Diversity: Overcoming Water Challenges Through Nature-Based Solutions

In this report, key water challenges (shortage, pollution, aquatic ecosystems threatened) have been identified via global modelling. The potential of NBS is reviewed for four sub-sectors: cities, food production, hydropower and flood protection, and grouped under three alternative pathways to meet key water challenges. The report finds that mainstreaming biodiversity into water policy requires integrated planning. Integrated Water Resource Management could provide an opportune starting point as a well-recognized integrating framework to guide the actual implementation of NBS in sub-sectors.

<https://www.cbd.int/gbo/gbo4/gbo4-water-policy.pdf>

Conservation International and BHP: Biodiversity Impacts and Benefits Framework

A multi-step framework that considers site-specific biological complexity and aims to evaluate the effectiveness of the biodiversity-focused activities undertaken by BHP, both “inside the fence” as a part of mitigating its operational activities, and “outside the fence” as a part of its broader social investment contributions. Phase 1 (now complete) identified a set of suitable biodiversity indicator categories that holistically evaluate marine, land and freshwater biodiversity impacts. Phase 2 (in progress) involves development of the framework to capture the context-specific nature of biodiversity at sites, identify site-level indicators to track over time and meaningfully aggregate this information at a corporate level to assess biodiversity-related impacts and benefits.

https://www.conservation.org/docs/default-source/publication-pdfs/ci-bhp_factsheet_biodiversity-impacts.pdf?Status=Master&sfvrsn=2a409cbe_3

Conservation International: Landscape Assessment Framework

The landscape approach has emerged as a method for holistically managing various land uses and stakeholder needs within a region, simultaneously addressing multiple objectives by seeking synergies and minimizing tradeoffs. Conservation International's Landscape Assessment Framework (LAF) is a structure for measuring, monitoring and communicating the sustainability of a landscape to guide local activities, inform policy and advise investments. The LAF is not a system for monitoring and evaluation of project outcomes, but rather of indicators that collectively characterize the sustainability of a landscape against broader management objectives. LAF application enables stakeholders to understand, for example, what is driving ecosystem degradation, the sustainability of agricultural productivity, or how people are benefiting from interventions. <https://www.conservation.org/projects/landscape-assessment-framework>

Conservation International and Massachusetts Institute of Technology

A collaboration to advance NBS to mitigate and adapt to climate change through research and education. The research component of the multi-year effort will focus on four projects with significant potential for carbon storage models, including in coastal mangroves. The project will provide students with opportunities to engage public audiences on climate issues and solutions through blog posts, op-eds and other digital/print communications. <https://www.conservation.org/blog/mit-ci-scientists-hack-climate-solutions>

Doris Duke Charitable Foundation: Natural Climate Solutions Special Initiative

The Doris Duke Charitable Foundation (DDCF) launched the five-year, \$20-million Natural Climate Solutions Special Initiative in 2015 with the aim to promote “natural climate solutions.” The initiative seeks to achieve three objectives: (1) protecting intact ecosystems, including forests, grasslands and wetlands; (2) restoring ecosystems through methods such as planting trees, restoring salt marshes and re-wetting peatlands; and (3) improving land management, including on farms, ranches and forests used for timber extraction. The following are the approaches DDCF is taking to achieve these objectives: improve the science and quantification of natural climate solutions; demonstrate how natural climate solutions accelerate restoration of public lands; support action in the United States by states and other subnational polities; innovative finance, markets and investment; and broadening the movement to increase international ambition and implementation.

<https://www.ddcf.org/what-we-fund/environment/goals-and-strategies/natural-climate-solutions-special-initiative/>

Dow and The Nature Conservancy: Ecosystem Services Identification & Inventory Tool

This tool helps Dow and the wider business community identify and incorporate the value of nature into business decision making. The objective is to rapidly and cost-effectively advance or promote the valuation of ecosystem services across a large corporation such as Dow. The tool enables businesses to identify and quantify the ecosystem services provided by a site and produce results that could easily be incorporated into existing company engineering and financial models. The tool helps identify ecosystem services not previously identified on the site, and supports educational efforts to build awareness of the value and benefits of nature, across Dow sites and beyond. <https://www.esiitool.com/about>

Ecosystem Services Market Consortium

The Ecosystem Services Market Consortium (ESMC) aims to change food and feed production from within by providing the tools and platform required to measure and incentivize change. Their national, voluntary, farmer-oriented ecosystem service payment program will reward farmers and ranchers for improvements in GHGs, water quality and water quantity associated with agricultural management practices. The ESMC's theory of change is that an economically viable ecosystem service market can deliver the estimated \$13.9 billion of private sector demand for these services by providing farmers and ranchers the tools required to monetize their stewardship actions. The ESMC presents a triple-win: farmers will access technical assistance and additional revenue streams while enhancing the resilience of their operations; corporate credit buyers will meet their sustainability goals; and the public will benefit from cleaner air and water and climate change mitigation. <https://d2fxn1d7fsdeeo.cloudfront.net/farmfoundation.com/wp-content/uploads/2019/08/24143020/ESMC-Overview-9-18-2019.pdf>

EPRI: United States National Opinion Survey on Stacking Environmental Credits

Key conclusions from the survey include: credit stacking may result in positive ecological value, but the credit stacking scenario plays a large part in whether this value can be obtained, and there is little consensus on how these ecological benefits are being verified; there is also little consensus on existing or pending regulations or regulatory guidance. This is a reflection of the fact that many different federal, state and local agencies may be involved in making and enforcing regulatory decisions; and there is a clear need for regulatory guidance, clarity and consistency, and no clear means of achieving it. <https://www.epri.com/#/pages/product/0000000000001024803/?lang=en-US>

Freshwater Health Index

The index measures the overall health of a watershed by making clear connections between the ecosystem and the benefits it provides to people. It allows resource managers, engineers, policy makers and other stakeholders to evaluate scenarios, understand tradeoffs, prioritize interventions and communicate basin health with a broad audience by: transforming data into commonly scaled indicators (on a 0-100 scale), providing a baseline diagnosis of a basin's health; tracking freshwater health over time through an iterative process between scientists, end-users and other stakeholders for a result that is salient, credible and useful; and evaluating potential impacts from climate change, land-cover change, population growth and water allocation decisions. Because the FHI helps make trade-offs more explicit, it can help direct policies and practices that maintain healthy watersheds into the future. <https://www.freshwaterhealthindex.org/>

Greenhouse Gas Protocol

The Greenhouse Gas Protocol establishes comprehensive global standardized frameworks to measure and manage GHG emissions from private and public sector operations, value chains and mitigation actions. Building on a 20-year partnership between WRI and the WBCSD, the protocol works with governments, industry associations, NGOs, businesses and other organizations. It offers online training on their standards and tools, as well as the “Built on GHG Protocol” review service, which recognizes sector guidance, product rules and tools that are in conformance with GHG Protocol standards. In 2016, 92 percent of Fortune 500 businesses responding to the CDP used GHG Protocol directly or indirectly through a program based on GHG Protocol. <https://ghgprotocol.org/about-us>

Natural Capital Coalition and the Social & Human Capital Coalition: Capitals Coalition

The Capitals Coalition is a global collaboration transforming the way decisions are made by including the value provided by nature, people and society. The coalition is made up of over 300 organizations (and engages many thousands more) who together represent all parts of society and span the global economy. Coalition organizations have united under a common vision of a world that conserves and enhances natural capital. Coalition organizations fall into seven broad stakeholder groups or “worlds.” These seven worlds are conservation & civil society, science & academia, business, membership organizations, standard setters & disclosure, finance and government & policy. <https://naturalcapitalcoalition.org/the-coalition/>

Nature Insurance Value: Assessment and Demonstration (NAIAD)

NAIAD seeks to develop concrete NBS approaches in response to flood and drought risks at nine demonstration sites across Europe, and to deliver replicable implementation methods. NAIAD works on development of financial instruments and novel business models in support of NBS, and contributes to academic knowledge on planning, increases the capacity of policy decision makers to integrate NBS in development planning, and contributes to the general awareness of the need for NBS and socioeconomic opportunities arising with their implementation at local, regional or European Union level. <http://naiad2020.eu/about-naiad/objectives/>

Ocean Health Index

A healthy ocean sustainably delivers a range of benefits to people now and in the future. The goals of this index are to obtain the maximum flows of ecological, social and economic benefits. Each goal measures the delivery of specific benefits with respect to a sustainable target. A goal is given a score of 100 if its maximum sustainable benefits are gained in ways that do not compromise the ocean’s ability to deliver those benefits in the future. Lower scores indicate that more benefits could be gained or that current methods are harming the delivery of future benefits. <http://www.oceanhealthindex.org/methodology>

Organisation for Economic Co-operation and Development: The Roundtable on Financing Water

The Roundtable on Financing Water is a global public-private platform established by the OECD, the Netherlands, the World Water Council and the World Bank. It draws upon political leadership and technical expertise, with the ambition of facilitating increased financing of investments that contribute to water security and sustainable growth. The roundtable engages a diversity of actors—governments and regulators in developed, emerging and developing economies, private financiers (e.g. institutional investors, commercial

banks, asset managers, impact investors), development financing institutions, bi-lateral donors, international organizations, academia and civil society organizations—focused on finding novel ideas and solutions. <https://www.oecd.org/water/roundtable-on-financing-water.htm>

Organisation for Economic Co-operation and Development: Social Impact Investment Initiative

This framework provides finance to organizations addressing social and/or environmental needs with the explicit expectation of a measurable social, as well as financial, return. It thus aims to foster economic development while achieving social outcomes. It is one way of channeling more resources towards the Sustainable Development Goals. <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/social-impact-investment-initiative.htm>

Pacific Institute: Multi-Benefit Framework

In collaboration with a broad range of stakeholders, researchers at the Pacific Institute and Professor Bob Wilkinson at the University of California, Santa Barbara have developed a framework to help water managers incorporate multiple benefits and trade-offs into water management decisions. This framework can help water managers engage with stakeholders and decision makers to improve support for a policy or project; identify cost sharing opportunities among project stakeholders; improve equitable investments in communities and minimize adverse and unintended consequences; quantify and compare the potential benefits provided by water management options; and optimize the investment of time, money, and other resources. <https://pacinst.org/multiplebenefits/>

Quantified Ventures

Quantified Ventures is an outcomes-based capital firm that drives transformative health, social and environmental impact. Practice areas include urban & coastal resilience, forestry & land use, agriculture, and health & human services. <https://www.quantifiedventures.com/>

Social Finance

Social Finance is a nonprofit organization dedicated to mobilizing capital to drive social progress. Through a set of innovative financing strategies called Pay for Success (PFS), they work to “disrupt the status quo, shifting mindsets to align resources with impact.” The core principles of PFS provide the foundation for this work: clearly defined outcomes, data-driven decisions, uncommon cross-sector partnerships, strong governance and accountability, and catalytic capital to drive impact. PFS strategies include social impact bonds, career impact bonds and outcomes rate cards. <https://socialfinance.org/>

United Nations Development Program

UNDP has already made a substantial investment in NBS. They support 819 active projects, representing a US\$2.52 billion investment, with US\$11.2 billion in co-finance. They see five major strategies for finding NBS to solve our development challenges. (1) Focus on disrupting the social and economic systems that cause biodiversity loss. This includes tackling the market, policy and governance failures that drive unsustainable production. (2) Support countries to fully implement their existing commitments to protect and restore ecosystems. These include the 2020 Convention on Biological Diversity Strategic Plan, the New York Declaration on Forests, the Sendai Framework, the Paris Agreement and the Bonn Challenge, among others.

(3) Transform the underlying systems that maintain an unsustainable status quo—the systems of finance, tenure, land rights, and policies—by helping governments identify and access new finance solutions. (4) Focus on strengthening resilience to climate shocks by promoting nature-based climate change adaptation and mitigation. (5) Help governments transition to green economies by supporting them to conduct green fiscal reform to correct market failures, phase out harmful incentives and subsidies, shift consumption patterns, and drive private capital toward products and production processes with lower resource footprints. <https://www.undp.org/content/undp/en/home/news-centre/speeches/2017/investing-in-innovative-nature-based-solutions.html>

United Nations REDD+

Launched in 2008 and building on the convening role and technical expertise of the Food and Agriculture Organization of the United Nations, the United Nations Development Program (UNDP) and the United Nations Environment Program. The program supports nationally-led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders, including indigenous peoples and other forest-dependent communities, in national and international REDD+ implementation. Additionally, the program supports national REDD+ readiness efforts in 65 partner countries, spanning Africa, Asia-Pacific and Latin America. <https://www.un-redd.org/how-we-work-1>

University of Oxford: Nature-Based Solutions Initiative

An interdisciplinary program of research, policy advice and education that brings together natural, physical and social scientists with economists, governance and finance experts from across the university and beyond. Its mission is to enhance understanding of the potential of NBS to address global challenges and increase their sustainable implementation worldwide. <https://www.naturebasedsolutionsinitiative.org/>

Verra: Verified Carbon Standard

The Verified Carbon Standard is the world's most widely used voluntary program. Almost 1500 certified VCS projects have collectively reduced or removed more than 200 million tons of carbon and other GHG emissions from the atmosphere. <https://verra.org/project/vcs-program/>

Wildlife Conservation Society (WCS): Intact Forests Program

This program's vision is to end all intact forest loss by 2030. Preserving our planet's last unbroken swaths of intact forest is one of the most powerful and cost-effective solutions we have to combat the global challenge of climate change. <https://www.wcs.org/our-work/solutions/climate-change/intact-forests>

Wisconsin Wetland Credits Bill

This bill requires developers to purchase wetland mitigation credits within the watershed they're affecting. The Department of Natural Resources requires creation or preservation of other wetlands as a condition of an individual permit allowing dredging or filling of wetlands. Builders can satisfy those conditions by purchasing credits from a mitigation bank located anywhere in Wisconsin. <https://www.eenews.net/greenwire/2019/11/26/stories/1061652587>

World Business Council for Sustainable Development + IUCN: Biodiversity for Business

As global business faces new and complex challenges and opportunities, the World Business Council for Sustainable Development's (WBCSD) science-based approach and targeted business solutions aim to scale up business impact. They target the realization of the Sustainable Development Goals through six work programs to achieve systems transformation. The main goal of this guide is to improve understanding and promote more and better use of these knowledge products to inform environmental risks and opportunities in business operations. The aim is to show how knowledge products can help in assessing, valuing, managing and reporting on businesses' impacts and dependencies on biodiversity, and in achieving compliance with environmental standards and certification schemes.

<https://www.wbcd.org/>; http://docs.wbcd.org/2014/03/Biodiversity_for_Business.pdf

World Resources Institute: The Ocean as a Solution to Climate Change

This report considers five areas of ocean-based climate action to mitigate GHG emissions. (1) Ocean-based renewable energy. (2) Ocean-based transport. (3) Coastal and marine ecosystems. (4) The ocean-based food system (wild capture fisheries, aquaculture and shifting human diets towards food from the sea). (5) Carbon storage in the seabed. http://oceanpanel.org/sites/default/files/2019-10/HLP_Report_Ocean_Solution_Climate_Change_final.pdf

WWF and Global Mangrove Alliance: Investing in Mangroves to Protect People

Aims to increase mangrove coverage 20 percent by 2030. The Global Mangrove Alliance brings together technical experts, civil society organizations, governments, local communities, businesses, funding agencies and foundations to accelerate a comprehensive, coordinated, global approach to mangrove conservation and restoration at a scale that matters. <https://www.worldwildlife.org/blogs/sustainability-works?month=9&year=2019>

WWF and USAID's Natural and Nature-Based Flood Management: A Green Guide

Provides a step-by-step framework for flood managers to understand the factors contributing to flood risk in their region, and to pull together the appropriate policies, NBS and traditional engineering to address the problem.

<https://www.worldwildlife.org/publications/natural-and-nature-based-flood-management-a-green-guide>

Youth4Nature

Youth4Nature has three main platforms to advanced NBS. (1) Knowledge sharing: connecting young people with scientists, experts and knowledge-holders to build a strong knowledge base among young people and create opportunities for youth to take action in their own communities. (2) Storytelling: providing a platform for youth from all corners of the world to tell their stories about NBS and have their voices heard. Together we are raising youth voices and building a collective movement of young nature and climate leaders acting for both the climate and ecological crises. (3) Building capacity: building the capacity of youth to advocate for NBS and be involved in their planning and implementation within their communities.

<https://www.youth4nature.org/areasofwork>

Appendix F. Benefit Accounting Initiatives for Nature-Based Solutions

American Carbon Registry

The American Carbon Registry (ACR) is a leading carbon offset program developing rigorous, science-based offset standards and methodologies in the oversight of ACR's online registry system. It provides GHG emissions methodologies for land-use change projects. Related methodologies for NBS projects include afforestation/reforestation, improved forest management, reduced emissions from deforestation and degradation (REDD), wetland restoration, and avoided conversion of grasslands & rangelands.

<https://americancarbonregistry.org/carbon-accounting/standards-methodologies>

Autocase Methodologies

Autocase uses a methodology developed by the US Army Corps of Engineers to quantify benefits of projects.

<https://sites.autocase.com/docs/methodologies.html>

Center for Neighborhood Technology: National Green Values Calculator

This tool is designed to quickly compare the performance, costs and benefits of green infrastructure, or low impact development, to conventional stormwater practices. The National Green Values Calculator is designed to take you step-by-step through a process of determining the average precipitation at your site, choosing a stormwater runoff volume reduction goal, defining the impervious areas of your site under a conventional development scheme, and then choosing from a range of green infrastructure BMPs to find the combination that meets the necessary runoff volume reducing goal in a cost-effective way.

<https://greenvalues.cnt.org/national/calculator.php>

Clean Energy Regulator: Carbon Accounting for Avoided Clearing of Native Growth

This project involves retaining areas of native forest that would otherwise be cleared in the normal course of events. Carbon is stored in the forest's trees as they grow, reducing the amount of GHG entering the atmosphere. The carbon stock held in the project's trees and debris is calculated using a computer modelling tool called the Full Carbon Accounting Model (FullCAM). FullCAM is used to model a "baseline scenario" (in which the land would normally be cleared) and a "project scenario" (in which the land is no longer cleared). The reference guide provides basic information about eligibility criteria and obligations that must be met to earn ACCUs from an avoided clearing of native regrowth project.

<http://www.cleanenergyregulator.gov.au/ERF/Choosing-a-project-type/Opportunities-for-the-land-sector/Vegetation-methods/Avoided-clearing-of-native-regrowth>

Conservation International: Biodiversity Impacts and Benefits Framework

The multi-step Biodiversity Impacts and Benefits Framework considers site-specific biological complexity and aims to evaluate the effectiveness of the biodiversity-focused activities undertaken. The framework will use pressure/state/ response measures of biodiversity impact and provide site-level indicators of biodiversity performance which can be aggregated at a corporate level.

https://www.conservation.org/docs/default-source/publication-pdfs/ci-bhp_factsheet_biodiversity-impacts.pdf?Status=Master&sfvrsn=2a409cbe_3

Conservation International: Landscape Assessment Framework

This framework offers a structure for measuring, monitoring and communicating the sustainability of a landscape to guide local activities, inform policy and advise investments. It is not a system for monitoring and evaluation of project outcomes, but rather of indicators that collectively characterize the sustainability of a landscape against broader management objectives.

<https://www.conservation.org/projects/landscape-assessment-framework>

Dow and The Nature Conservancy: Ecosystem Services Identification & Inventory Tool

This tool enables the company to identify and quantify the ecosystem services provided by a site and produce results that could easily be incorporated into existing company engineering and financial models. The tool helps Dow and the wider business community identify and incorporate the value of nature into business decision making. <https://www.esiitool.com/about>

EKLIPSE: Impact Evaluation Framework to Support Planning and Evaluation of Nature-Based Solutions Projects

The aim of this EKLIPSE activity is to devise an impact evaluation framework that can guide the design, development, implementation and assessment of NBS demonstration projects in urban contexts.

http://www.eklipse-mechanism.eu/apps/Eclipse_data/website/EKLIPSE_Report1-NBS_FINAL_Complete-08022017_LowRes_4Web.pdf

Freshwater Health Index

This index measures the overall health of a watershed by making clear connections between the ecosystem and the benefits it provides to people. It allows resource managers, engineers, policy makers and other stakeholders to evaluate scenarios, understand tradeoffs, prioritize interventions and communicate basin health with a broad audience by: transforming data into commonly scaled indicators (on a 0-100 scale), providing a baseline diagnosis of a basin's health; tracking freshwater health over time through an iterative process between scientists, end-users and other stakeholders for a result that is salient, credible and useful; and evaluating potential impacts from climate change, land-cover change, population growth and water allocation decisions. Because the index helps make trade-offs more explicit, it can help direct policies and practices that maintain healthy watersheds into the future. <https://www.freshwaterhealthindex.org/>

Global Biodiversity Framework

The vision of the framework is a world of living in harmony with nature where: By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people. The framework has five long-term goals with the mission to take urgent action across society to put biodiversity on a path to recovery. The framework has 20 action-oriented targets for 2030 which, if achieved, will contribute to the outcome-oriented goals for 2030 and 2050. Actions to reach these targets should be implemented consistently and in harmony with the Convention to the Biological Diversity and other relevant international obligations, taking into account national socioeconomic conditions. The actions are grouped into 1) reducing threats to biodiversity; 2) meeting people's needs through sustainable use and benefit-sharing; and 3) tools and solutions for implementation and mainstreaming.

<https://www.cbd.int/doc/c/efb0/1f84/a892b98d2982a829962b6371/wg2020-02-03-en.pdf>

Greenhouse Gas Protocol

The Greenhouse Gas Protocol provides accounting and reporting standards, sector guidance, calculation tools and trainings for business and government. It establishes a comprehensive, global, standardized framework for measuring and managing emissions from private and public sector operations, value chains, products, cities and policies. <https://ghgprotocol.org/>

Green Infrastructure Leadership Exchange: Co-Benefits Valuation Tool

This tool provides a framework, methods and values to support rapid screening-level analysis of the costs and benefits associated with a range of green infrastructure investments. The range of benefits include combined sewer overflow event reduction, stormwater capture for water supply, stormwater quality, environmental education, aesthetic value and carbon sequestration.

<https://giexchange.org/green-infrastructure-co-benefits-valuation-tool/>

Integrated Valuation of Ecosystem Services and Tradeoffs

Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) is a suite of models used to map and value the goods and services from nature that sustain and fulfill human life. InVEST enables decision makers to assess quantified tradeoffs associated with alternative management choices and to identify areas where investment in natural capital can enhance human development and conservation. The toolset includes distinct ecosystem service models designed for terrestrial, freshwater, marine and coastal ecosystems, as well as a number of “helper tools” to assist with locating and processing input data and with understanding and visualizing outputs. <https://naturalcapitalproject.stanford.edu/software/invest>

i-Tree

i-Tree is a state-of-the-art, peer-reviewed software suite from the United States Forest Service that provides urban and rural forestry analysis and benefits assessment tools. The i-Tree tools can help strengthen forest management and advocacy efforts by quantifying forest structure and the environmental benefits that trees provide. Different tools provide different outputs. Some benefits include carbon, air pollution and hydrology.

<https://www.itreetools.org/about>

Landscape Architecture Foundation: Landscape Performance Series

The Landscape Performance Series is an online set of resources to help designers, agencies and advocates evaluate performance, show value and make the case for sustainable landscape solutions.

<https://www.landscapeperformance.org/browse>

Michigan State University and EPRI: Methodology to Quantifying Nitrous Oxide (N₂O) Emissions Reductions from Reduced Use of Nitrogen Fertilizer on Agricultural Crops

This methodology makes it possible for farmers to participate in carbon markets by creating GHG offsets through reductions in the amount of nitrogen used to fertilize crops. These offsets can be sold to other carbon market participants to meet GHG emission reduction targets or requirements

https://americancarbonregistry.org/carbon-accounting/standards-methodologies/emissions-reductions-through-reduced-use-of-nitrogen-fertilizer-on-agricultural-crops/msu-epri-methodology-acr-v1-0_final.pdf

Ocean Health Index

The Ocean Health Index is a comprehensive framework used to measure ocean health from global to local scales. <http://www.oceanhealthindex.org/>

Organisation for Economic Co-operation and Development: Valuation Techniques for Biodiversity

This handbook focuses on the nature of values associated with biological diversity and the methodological approaches that can be adopted to assign values for policy purposes. It adopts a variety of case studies to illustrate the valuation process in OECD countries.

<http://www.oecd.org/env/resources/valuationtechniquesforbiodiversity.htm>

Organisation for Economic Co-operation and Development: Social Investment Framework

This framework provides finance to organizations addressing social and/or environmental needs with the explicit expectation of a measurable social, as well as financial, return. It thus aims to foster economic development while achieving social outcomes. It is one way of channeling more resources towards the Sustainable Development Goals.

<https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/social-impact-investment-initiative.htm>

Pacific Institute: Multi-Benefit Framework

The Multi-Benefit Framework provides a four-step process and supporting resources for systematically identifying and evaluating the multiple benefits and trade-offs of water management into decision making.

In collaboration with a broad range of stakeholders, researchers at the Pacific Institute and Professor Bob Wilkinson at the University of California, Santa Barbara have developed a framework to help water managers incorporate multiple benefits and trade-offs into water management decisions.

<https://pacinst.org/multi-benefit-framework-details/>

Restore the Earth Foundation: EcoMetrics

EcoMetrics is a methodology and tool that assesses and values the spectrum of impacts generated by projects including economic, environmental and social impacts and captures the full value of the project in a monetized form. Methodology uses an application of social return on investment to the environmental sector. <http://restoretheearth.org/how-we-work/we-value/ecometrics/>

Soil & Water Assessment Tool

The Soil & Water Assessment Tool (SWAT) is a small watershed to river basin-scale model used to simulate the quality and quantity of surface and ground water and predict the environmental impact of land use, land management practices and climate change. SWAT is widely used in assessing soil erosion prevention and control, non-point source pollution control and regional management in watersheds. <https://swat.tamu.edu/>

Sustainable Rice Platform

The Sustainable Rice Platform (SRP) Standard for Sustainable Rice Cultivation is the world's first voluntary sustainability standard for rice. The standard is complemented by a set of 12 quantitative performance indicators. By identifying “hotspots,” the indicators enable users to monitor impacts of adaption of climate-smart best practices—as well as other field interventions such as training. <http://www.sustainableice.org/>

United Nations Environment Program: Aligning Biodiversity Measures for Business

This initiative seeks to establish a common view amongst key stakeholder on the measurement, monitoring and disclosure of corporate biodiversity impacts and dependencies. Key outputs are recommendations for the private sector and policy makers on methodologies to measure corporate biodiversity performance, as well as a summary information document for submission to the Convention on Biological Diversity parties highlighting the results of the process.

https://www.unep-wcmc.org/system/comfy/cms/files/files/000/001/556/original/20190614_AligningMeasuresFlyer_Communications_FINAL_210619.pdf

Verra: Verified Carbon Standard

This standard sets out detailed procedures for quantifying the real GHG benefits of a project and provides guidance to help project developers determine project boundaries, set baselines, assess additionality and ultimately quantify the GHG emissions that were reduced or removed. Any methodology developed under the United Nations Clean Development Mechanism can be used for projects and programs registering with the standard. The same is true for methodologies developed by the Climate Action Reserve, with the exception of their forest protocols. <https://verra.org/>

Volumetric Water Benefit Accounting

This is a common method for assessing the benefits of water stewardship activities in a comparable way and ensuring they address current or projected water challenges and contribute to public policy priorities. <https://www.wri.org/publication/volumetric-water-benefit-accounting>

Water Evaluation Planning System

The Water Evaluation and Planning (WEAP) system is a user-friendly software tool that takes an integrated approach to water resources planning. Freshwater management challenges are increasingly common.

Allocation of limited water resources between agricultural, municipal and environmental uses now requires the full integration of supply, demand, water quality and ecological considerations. WEAP aims to incorporate these issues into a practical yet robust tool for integrated water resources planning.

<https://www.weap21.org/>

WRI: Green-Gray Assessment

The Green-Gray Assessment is a six-step methodology that can be used for investigating and valuing the costs and benefits of integrating green (or natural) infrastructure into existing water supply systems to improve their performance. Quantifying the costs of green infrastructure investments in upstream watersheds and benefits for urban water supply systems can inform important investment decisions of water suppliers, water regulators and land conservation and restoration organizations.

<https://wriorg.s3.amazonaws.com/s3fs-public/green-gray-assessment.pdf>

Appendix G. Valuation Initiatives for Nature-Based Solutions

Beverage Industry Environmental Roundtable (BIER): True Cost of Water Toolkit

Developed by a group of leading beverage businesses, this is an easy-to-use excel tool for beverage facilities to estimate direct costs associated with their most water- and resource- intensive processes, beyond just the cost of water from the tap. The costs are estimated for energy use, water use and water treatment.

The tool's new revenue-at-risk assessment helps businesses better estimate the full value of water for their operational processes and identify the at-risk revenue through current and future water scarcity.

<https://www.bieroundtable.com/publication/true-cost-of-water-toolkit/>

Carbon Credit Trading

Carbon credits or markets are generic terms for tradeable certificates or permits representing the right to emit carbon dioxide or an equivalent amount of a different GHG. The goal is to reduce GHG emissions. One carbon credit is usually equal to one tonne of carbon dioxide or an equivalent amount of a different GHG. GHGs are capped and allocated amongst users. The users can then sell their extra allowances. Several countries have well-known emissions-trading programs such as the European Union's Emissions Scheme.

<https://www.edf.org/climate/how-cap-and-trade-works>

Coalition for Private Investment in Conservation: Green Infrastructure for Watershed Management Working Group

This working group aims to develop financial vehicles to attract private capital to projects and businesses that contribute to restoration of wetlands and rivers. It will develop financial structure blueprints for projects and businesses that restore green infrastructure resulting in better stormwater management for cities, drought reduction, flood protection, improvement of water quality and/or better access and supply for drinking water, irrigation, industry and energy.

<http://cpicfinance.com/blueprints/green-infrastructure-for-watershed-management/>

Ecolab: Water Risk Monetizer

This financial modeling tool helps businesses factor water scarcity into decisions that support business growth and help ensure availability of water resources for future generations (Ecolab, 2020). For each site, the tool provides assessments of: incoming water risks (monetary value of human health and ecosystems and the future cost of incoming water treatment); outgoing water risk (monetary value of the outgoing water pollution on human health and ecosystems and the future costs of water treatment); potential revenue at risk (monetary value of the impacts of water use versus availability based on water required to do business); and enterprise risk profile (assessment of each facility's risk based on the three-year projected output growth and location specific water stress). <https://tool.waterriskmonetizer.com/>

Ecosystem Services Market Consortium

The Ecosystem Service Market Consortium (ESMC) is an ambitious national-scale effort to incentivize farmers and ranchers to improve soil health systems by creating a program to quantify, verify and monetize ecosystem services from agriculture working lands. The ESMC will change food and feed production from within by providing the tools and platform required to measure and incentivize change. This national, voluntary, farmer-oriented ecosystem service payment program will reward farmers and ranchers for improvements in GHGs, water quality, and water quantity associated with agricultural management practices. Ecosystem services outcomes will be monetized in two ways: by meeting corporate GHG inventory reduction and water risk needs, particularly for food and beverage and agricultural supply chain businesses; and by generating carbon offset and water quality credits within existing carbon and water quality markets—meeting the demands of multiple sectors, including energy businesses, the airline industry and municipalities.

<https://d2fxn1d7fsdeeo.cloudfront.net/farmfoundation.com/wp-content/uploads/2019/08/24143020/ESMC-Overview-9-18-2019.pdf>

Environmental Impact Bonds

Environmental impact bonds (EIB) are instruments for financing large projects that pay returns based on outcomes. Like green bonds, they are used to raise funding for environmentally sustainable projects, such as green infrastructure. Unlike green bonds, however, the financial return of the investment is tied directly to the success of the project. Investors can only collect a return on their investment if the project proves to be successful. In the case of financing green infrastructure projects using an EIB, investors see a financial return when a demonstrable difference to the environment is achieved. Once bonds have been issued, the issuer uses the obtained funds to pay for their planned green infrastructure solutions. Following an evaluation period, the issuer pays the investors an outcome profit when there is demonstrable proof that the project has performed better than expected. If it underperforms, however, the investor must pay the municipality a “risk-sharing” payment. This usually means that the investor receives little or no interest.

<https://waterfm.com/a-closer-look-at-environmental-impact-bonds/>

Green Bonds

Green bonds were created to fund projects that have positive environmental and/or climate benefits. Like regular bonds, a green bond is a fixed-income financial instrument for raising capital from investors through the debt capital market. Typically, the bond issuer raises a fixed amount of capital from investors over a set period of time (the “maturity”), repaying the capital (the “principal”) when the bond matures and paying an agreed amount of interest (“coupons”) along the way. Green bond proceeds can go toward new or existing projects that are meant to have positive environmental or climate effects. Inside that, the range is vast. It covers energy, transport, waste management, building construction, water and land use. Some definitions also include communications and information technology. A cumulative \$580 billion of green bonds were sold through 2018, according to Bloomberg New Energy Finance. Another \$170 billion to \$180 billion are likely to be sold in 2019.

<https://www.oecd.org/environment/cc/Green%20bonds%20PP%20%5Bf3%5D%20%5Blr%5D.pdf>

Green Water Credits

Green Water Credits support upstream farmers investing in improved green water management practices. It is a form of payment of environmental services. The management of green water, the water held in soil and available to plants, comprises effective soil and water conservation practices put in place by land users. Small, regular payments by downstream water users enable farmers to adopt sustainable management of land and water and combat rural poverty by diversifying income. A mechanism must still be established for collection and payment of credits, verification of claims, and settlement of disputes. Payments may be financed by a mix of water users and public utilities, insurers and general taxation.

<https://www.isric.org/projects/green-water-credits-gwc>

Mandatory Carbon Reporting

Data from mandatory reporting programs, such as projected GHG emissions, can inform a country's climate change and energy efficiency policy. GHG reporting programs can support emissions trading schemes because they provide uniform methodologies to calculate, report, monitor and verify emissions, which is essential to building trust and provides reliable data. Examples of emissions trading schedules are cap-and-trade and credits. Cap-and-trade sets a cap on allowable emissions and distributes allowances or auctions off credits. Members with extra allowances can sell or save them for future use. Credits are used with cap-and-trade where users fund existing emissions reduction projects. Currently, mandatory reporting programs are required by 40 countries globally. <https://www.wri.org/blog/2015/05/global-look-mandatory-greenhouse-gas-reporting-programs>

United States Environmental Protection Agency: Water Quality Trading

Water quality trading is an innovative, market-based, cost-effective mechanism to help achieve local water quality improvements. In water quality trading, sources with high costs of reducing pollution (abatement costs) can purchase equal or greater pollution reductions from sources with lower costs. This cost difference provides an incentive for trading to occur. Producers, ranchers and forest landowners may generate water quality credits for sale in water quality markets. Once eligible, producers can install additional BMPs that generate even more water quality benefits. These additional benefits can then be offered for sale on water quality markets. Typically, a credit is defined as a quantity of delivered pollution that has been reduced. In other words, a credit is equal to the amount of the pollution that actually meets a water body. <https://www.epa.gov/npdes/water-quality-trading>

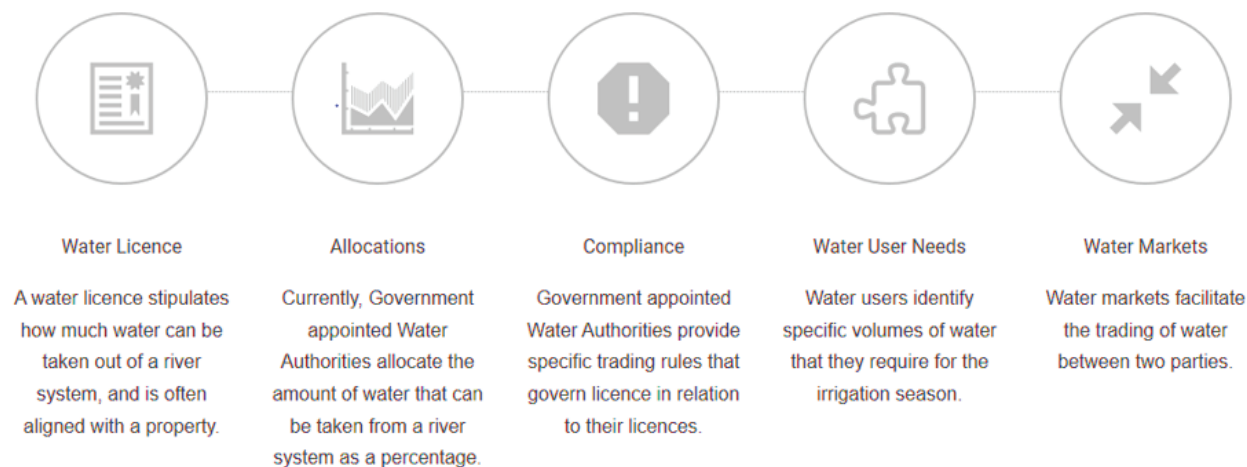
Water Trading

Water trading, the buying and selling of water access rights, takes place across the world as water resources are stretched by a rising global population, climate change and increasing urbanization. According to some economists, water trading can enable efficient water allocation. The market price acts as an incentive for users to allocate resources to the activities with the highest value. However, the social and environmental outcomes of water trading schemes are heavily debated. The water trading schemes in operation in Australia, South Africa and certain states in the United States are considered to be among the most developed and sophisticated.

<https://www.reuters.com/article/us-water-trade/factbox-water-trading-schemes-around-the-world-idUSTRE7772GM20110808>

FIGURE G-1. The elements of water trading

WATER TRADING ELEMENTS



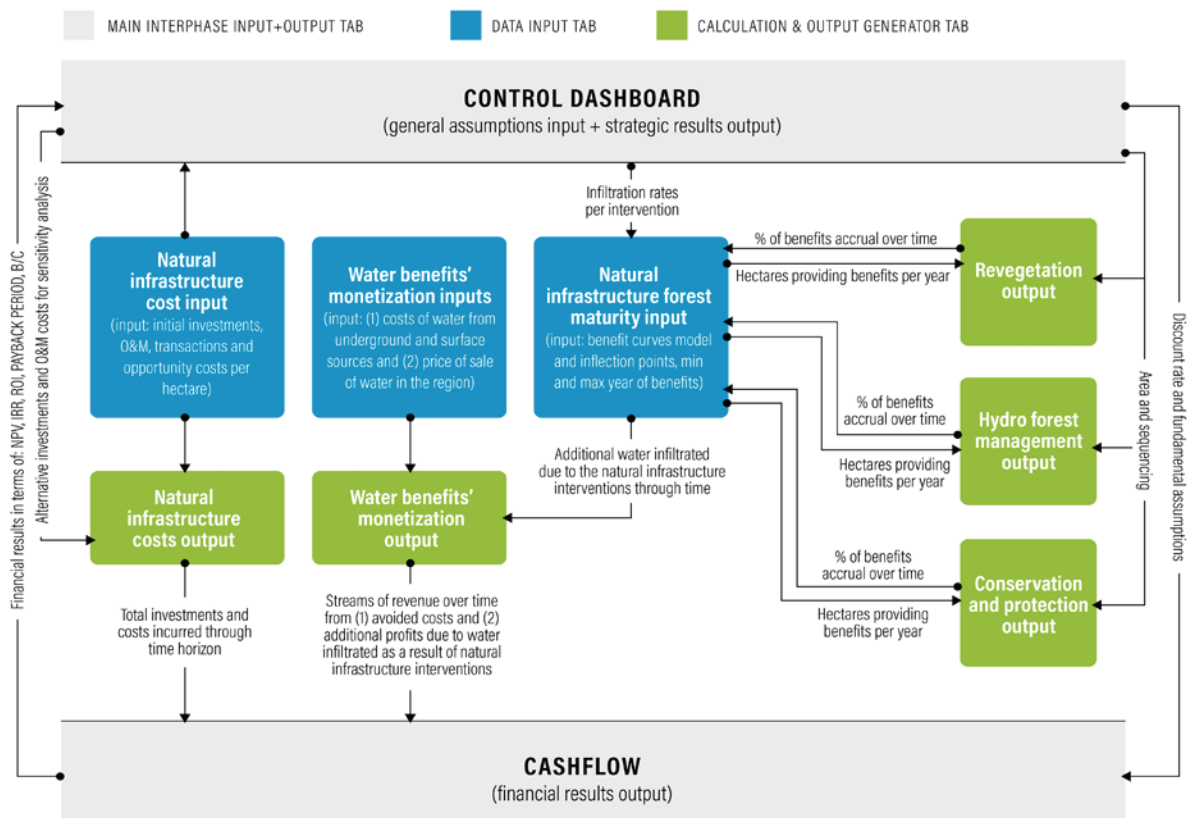
Source: www.waterfind.com

WRI: Natural Infrastructure for Aquifer Recharge Financial Calculator

Currently in the prototype phase, this calculator is an excel-based tool with a flexible financial model that estimates the private costs and benefits, including the return on investment, of natural infrastructure interventions designed to enhance aquifer recharge. This tool was designed to highlight the role that natural infrastructure can play in water security. The calculator can demonstrate the benefits that natural infrastructure can have for aquifer recharge, which is a key element of water security. The calculator translates aquifer recharge impacts into easy-to-understand financial terms to evaluate its related ROI. It also improves natural infrastructure program design. It provides an analytical framework to determine the ideal type and scale of intervention and to estimate the necessary amount of funding to implement different natural infrastructure strategies. Finally, it can identify key data gaps and sources of uncertainty (e.g., data, scientific and behavioral uncertainty) that would have an impact over the business case, and which should be addressed in the program's design process.

<https://www.wri.org/publication/natural-infrastructure-financial-calculator>

FIGURE G-2. Control dashboard showing inputs and outputs of Natural Infrastructure for Aquifer Recharge Financial Calculator



Appendix H. Private Sector Case Studies

METHOD

To improve our understanding of current corporate investment in NBS, we searched for and catalogued NBS case studies available online. We were seeking a range of NBS project types across differing geographies, habitat types and industry sectors. The criteria for case studies to be included in the research were:

1. Must be publicly available via internet search
2. Must fit within the IUCN definition of NBS: “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.”
3. Must have private sector investment and/or be tied to a corporate water stewardship goal
4. Must state water benefits (quantity or quality) and/or be implemented in a freshwater habitat
5. Should state at least one co-benefit (i.e., carbon, biodiversity, etc.)

From each case study, we sought eight pieces of information:

1. Project overview
2. Geography (country, continent)
3. Organizations (company and implementing partners)
4. Habitat and intervention (based on IUCN habitat definitions and University of Oxford intervention definitions – see Appendix B for more detail on classifications)
5. Decision-making process to select the nature-based solution
6. Benefits considered
7. Methods and frameworks to quantify the benefits
8. Ways to scale NBS

RESULTS

In total, we identified and assessed 70 case studies, including 46 projects from a 2014 report documenting Coca Cola’s “watershed protection” replenishment projects (see below for a full project list). The projects varied across geographies, habitats and intervention types. As shown in the figure below (Figure H-1), the most common project types were forest restoration, wetland or stream restoration (the “wetland” habitat category includes rivers, streams, and lakes), and agricultural management practices.

FIGURE H-1. Habitat and intervention types across 70 reviewed case studies

		INTERVENTION TYPE			
		Restoration	Protection	Management	Created
HABITAT TYPE	Forest	18	12	4	1
	Savanna, Shrubland, Grassland and Desert	10	4	1	
	Marine, Estuaries and Intertidal	3		1	
	Wetland	21	1		1
	Rocky and Subterranean				
	Artificial and Introduced	1		1	11
	Terrestrial Agriculture	3		20	1

The geographic spread of projects was uneven, with more projects found in North and South America, some in Europe and Asia, few in Africa, and none found for Australia.

FIGURE H-2. Case study counts by continent across 70 reviewed case studies

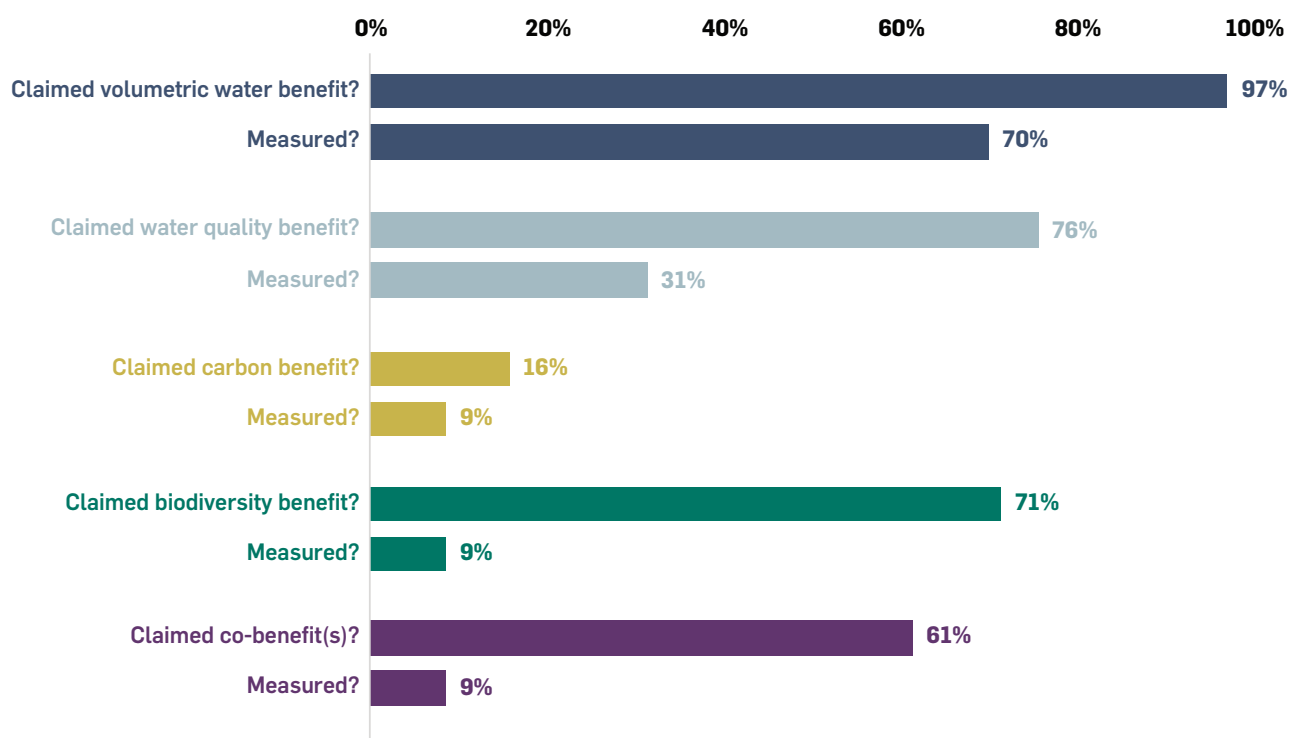


DISCUSSION

This process of gathering and analyzing case studies on private sector investments in NBS brought to light several insights that highlight the importance of this project and weigh into our team's discussion on scoping subsequent project phases.

While all projects made claims about benefits, most projects did not provide information on benefit quantification. If benefits were quantified, the most common method was an estimate calculation. In some cases, benefit estimates were provided without any discussion of how the estimates were calculated, so there is an information gap. Biodiversity, a key component of the IUCN definition of NBS, was rarely measured. Similarly, benefits to human wellbeing were often assumed rather than quantified.

FIGURE H-3. Percentage of nature-based solutions projects which assessed claimed and measured benefits across 70 reviewed case studies



The case studies also demonstrated that businesses are defining and/or scoping NBS differently. In some cases, NBS was synonymous with watershed protection. In other cases, on-farm irrigation efficiency improvements, such as switching to drip irrigation, were considered NBS. In others, projects that were directly in line with a company's core business model were considered NBS, like a pulp and paper company planting trees for subsequent harvest.

These findings affirm the need for a) improved unity and clarity on the definition of NBS, and b) increased guidance on identifying and measuring the benefits of NBS, particularly in the context of corporate water and carbon targets—but with care not to forget key co-benefits such as biodiversity and human well-being.

LIST OF CASE STUDIES

TABLE H-1. Project and company details across 70 reviewed case studies

Project	Company
Agricultural Water Use Efficiency on Barley Fields	Heineken
BirdReturns	Sacramento Valley rice farmers
Chalk Creek Flow Restoration	The Coca-Cola Company
Colorado Regenerative Agriculture	Tierra Vida Farms, other farmers
Conservation and Restoration of Ramsar Site Lagunas de Guanacache Desaguardero and del Bebedero	The Coca-Cola Company
Conservation of Existing Land Cover	The Coca-Cola Company
Constructed Wastewater Treatment Wetland in Seadrift, Texas	Dow Chemical Company
Constructed Wetland to Reduce Nutrient Load to James River, VA	Phillip Morris USA
Cypress Reforestation in North America's Amazon	Dow Chemical Company
Drain Tile Removal in Midewin National Tallgrass Prairie, Illinois	The Coca-Cola Company
Floodplain Reconnection and Wetland Restoration Mollicy Farms, Louisiana	The Coca-Cola Company
Forest Protection and Restoration in the Haina-Duey Subwatershed, Santo Domingo Water Fund	The Coca-Cola Company
Forest Conservation in the Daule River Watershed	The Coca-Cola Company
Forest Conservation in the Greater Tarcoles River Watershed, Agua Tica Water Fund	The Coca-Cola Company
Forest Conservation in the Greater Tarcoles River Watershed, Agua Tica Water Fund	The Coca-Cola Company
Forest Conservation in the Higua River Watershed, Yaque del Norte Water Fund	The Coca-Cola Company
Forest Conservation in the Rio Grande Rio Chica Watershed, Corporacion Cuenca Verde	The Coca-Cola Company
Forest Maintenance in Japan	The Coca-Cola Company
Forest Protection and Restoration in the El Zapote Watershed, Cordillera Alux Forest Reserve	The Coca-Cola Company
Forest Protection and Restoration in the Mahomita Microwatershed, Santo Domingo Water Fund	The Coca-Cola Company
Forest Protection in the Rio Siecha Watershed, Agua Somos Water Fund	The Coca-Cola Company
Forest Protection, Agroforestry Promotion, and Reforestation in the Xaya-Pixcaya Watershed	The Coca-Cola Company
Green Roof and Water Management	LafargeHolcim Philippines
Improving Fort Shaw Irrigation District Water Efficiency to Improve Sun River Flow	The Coca-Cola Company
Inter-Cropping Barley and Olives to Save Water and Soil	Heineken
Invasive Plant Species Removal in California	The Coca-Cola Company
Invasive Plant Species Removal in South Africa	SABMiller, Woolworths, Sanlam, Nedbank
Invasive Species Removal in Angeles National Forest, California	The Coca-Cola Company
Itza-Popo: Replenishing Groundwater Through Reforestation	The Volkswagen Group
Laguna Irrigation District Groundwater Recharge Project	The Coca-Cola Company
Life Plus Environment Program	The Coca-Cola Company
Lower Flint River Watershed Restoration	The Coca-Cola Company
Managing Water Quality at Old Copper Mine Site	BHP
Mangrove Forest Protection	Apple
Mexico Restoration and Reforestation Program	The Coca-Cola Company
New Acre Project	Multiple; founding sponsor is TD Bank Group
North America Rain Barrel Donation Program	The Coca-Cola Company
Oxapampa Ashaninka Yanesha Biosphere Reserve, Central Forest	The Coca-Cola Company
Paw River Watershed Restoration	The Coca-Cola Company

Project	Company
Phytoremediation for Groundwater Contamination	Dow Chemical Company
Prickly Pear Creek Re-Watering Project	The Coca-Cola Company
Produced Water Treatment Using Reed Beds	Shell Petroleum Company; BAUER Nimr LLC, Oman
Project Khula: Protection of Freshwater Resources While Improving the Livelihoods of Disadvantaged Sugarcane Growers in South Africa	The Coca-Cola Company
Protecting Forests from Land Development	The Coca-Cola Company
Protecting the Rio Grande/Rio Bravo River	The Coca-Cola Company
Protection and Restoration of Natural Paramo Areas in the Guambi Watershed, Quito Water Fund	The Coca-Cola Company
Quarry Rehabilitation to Create Wetlands	LafargeHolcim France
Rainwater Harvesting and Aquifer Recharge in India	The Coca-Cola Company
Replenishing Upper Guadiana Aquifers: "Mision Posible"	The Coca-Cola Company
Rejoso Watershed Rice Production	Danone S.A.
Reserves in La Calera, Province of Cordoba: Management as a Tool for Basin Recovery	The Coca-Cola Company
Restoration of Lake Sazanie in the Volga-Akhtuba Floodplain	The Coca-Cola Company
Restoration Project in Guadiana River Basin	The Coca-Cola Company
Restoring the Wetlands of Donana	Heineken
River Nar Land Management Improvements	The Coca-Cola Company
Soil Conservation and Water Harvesting in Mountains of Syria	Smallholder farmers; The Coca Cola Foundation
Sungai Way Rehabilitation Program	Heineken Malaysia
Sustainable Rice Landscapes Initiative	Smallholder rice farmers
Suzano Forest Restoration Program	Suzano
Tancat de la Pipa	The Coca-Cola Company
Terrebonne Biodiversity and Community Resilience Project	BHP
Tommy Thompson Park Wetland Regeneration	The Coca-Cola Company
Transboundary Community Water Management	The Coca-Cola Company
Tree Planting to Protect Water Resources in Rwanda	Heineken, Bralirwa
Tropical Rainforest Conservation in the Panama Canal Watershed	The Coca-Cola Company
Upper Methow River Restoration	The Coca-Cola Company
Wetland Restoration in Highland Indigenous Communities of Alto Tarapaca, I Region, Chile	The Coca-Cola Company
Wetland Restoration in Jialing River Basin	The Coca-Cola Company
Wetland Treatment to Improve Quality of Lake Wuliangsu	The Coca-Cola Company
Zimbabwe Water Harvesting	Smallholder farmers
Zone Libellule, the Dragonfly Zone	SUEZ

HIGHLIGHTED CASE STUDIES

We selected four representative case studies to highlight. The case studies provide a snapshot of the kinds of projects assessed and provide a sample of the kind of information we gathered for all 70 case studies.

Rejoso Watershed Rice Production

Overview	Danone S.A., its Ecosystem Fund and the World Agroforestry Center (ICRAF) have joined forces in Indonesia to protect the threatened Rejoso watershed. Various NBS have been employed to improve water conditions, mitigate flood risks and minimize erosion. Based on several scientific studies conducted with universities, the focus now lies on climate-smart rice production practices downstream, and drill management for more efficient water use. The objective of the project is to widely introduce, pilot and upscale climate smart paddy cultivation practices among smallholders in the downstream of Rejoso watershed.
Geography	Indonesia
Organization(s)	Danone S.A., ICRAF, smallholder rice farmers
Habitat & intervention	Terrestrial agriculture, management
Decision-making process	Scientific studies conducted with universities identified best practices
Benefits considered	• Reduce water consumption • Reduce carbon emissions • Reduce chemical pesticide application • Increase farmer income • Also using Sustainable Rice Platform metrics.
Methods or frameworks	On-farm monitoring
Ways to scale	• Strengthen local groups and networks towards collective actions on climate-smart paddy cultivation initiatives • Leverage grants and loans for farmers from financial institutions

Produced Water Treatment Using Reed Beds in Oman

Overview	Petroleum Development Oman (PDO), a joint venture of the government of Oman and Royal Dutch Shell, developed a four-tier, gravity-based wetland system to treat produced water from oil exploration, and reduce costs and GHG emissions associated with treating and re-injecting the produced water via deep well disposal. The project, which became operational in 2010, represents the world's largest commercial wetland currently covering more than 360 hectares and treating >95,000 cubic meters of produced water per day.
Geography	Nimr Reed Beds, Oman (property owned by PDO)
Organization(s)	PDO and BAUER Nimr LLC, Oman, a subsidiary of BAUER Resources GmbH in Germany
Habitat & intervention	• Wetland (created) • Special clay soil used to ensure seal (natural, not synthetic) • Evaporation ponds • Goes to gray infrastructure treatment center first to separate oil and water
Decision-making process	• Seeking to reduce costs and GHG emissions from treatment and reinjection of produced water • Needed a champion to propel the project forward, even though initial study demonstrated positive results
Benefits considered	• Cost savings • Energy savings (98 percent reduction as compared to traditional treatment and injection) • GHG emissions reduction (98 percent, correlated to energy savings) • Construction time for wetland was half the setup time required for traditional gray infrastructure • Habitat for fish and migratory birds • Increase biodiversity (including diversity in reed species)
Methods or frameworks	Conducted a two-year pilot study to evaluate reed bed efficiency: measured temperature, evaporation, evapotranspiration rates, water volume, water flow, retention time, hydraulic load
Ways to scale	• Create a more comprehensive environmental footprint and economic analysis to compare green vs gray infrastructure • Develop educational resources to help identify green infrastructure opportunities and advise where failures are likely to occur • Establish network for sharing knowledge, skills and insights • Engage with decision makers early on in the process to ensure NBS are being considered as an option

Replenishing Groundwater Through Reforestation in Mexico

Overview	The Iztaccíhuatl-Popocatepetl (Izta-Popo) project focused on ecosystem restoration on volcanic slopes of the valley by planting native trees. The project also added compost to the soil to support tree establishment, and constructed pits and earthen dams to retain water for the trees as they were establishing and to help with groundwater recharge. Over six years, the Izta-Popo project team planted 490,000 trees, and installed 91,000 pits and 430 earthen banks to preserve water on over 750 Ha.
Geography	Puebla-Tlaxcala Valley, Mexico
Organization(s)	The Volkswagen Group Comisión Nacional de Áreas Naturales Protegidas
Habitat & intervention	Rocky/shrubland (restoration)
Decision-making process	• Water supply security for Volkswagen plant and local population: prevent water rationing, water cost increases, local unrest (license to operate) • 10-person cross-organizational team developed the project • Had support of Mexico's Secretary of Environment
Benefits considered	• Tree plantings, pits and earthen dams will enable more than 1,300,000 cubic meters of additional water per year to be fed into the aquifer • Implicit ecosystem benefit, but not clearly stated
Methods or frameworks	Not stated
Ways to scale	• Allow local communities to participate and feel ownership of project • Increase stakeholder buy-in, particularly from water supply agency • Raise awareness about importance of environmental stewardship by showcasing these kinds of projects • Scale within a company (Volkswagen de Mexico has initiated a similar project in Filao, Mexico)

Cypress Reforestation Project in North America's Amazon

Overview	Planting 200 acres of bald cypress trees in the Point-aux-Chenes Wildlife Management Area of Montegut, Louisiana.
Geography	Louisiana, USA
Organization(s)	Dow, Restore the Earth Foundation, International Olympic Committee
Habitat & intervention	Forest (restoration)
Decision-making process	• Desire to create a positive legacy • Achieve carbon reduction targets • Contributing to "Valuing Nature" corporate sustainability goal • Accelerate adoption of lower-carbon technologies and solutions to reduce GHGs
Benefits considered	• Resilience/protection from storms • Improve water quality • Enhance wildlife habitat • Capture carbon • Improve watershed conditions in Mississippi River Basin • \$11 million in environmental, social and economic value
Methods or frameworks	• Restore the Earth Foundation's EcoMetrics Model • Cypress Reforestation Social Return on Investment Report
Ways to scale	Long-term sustained public-private partnerships

The CEO Water Mandate's six core elements:

DIRECT OPERATIONS

Mandate endorsers measure and reduce their water use and wastewater discharge and develop strategies for eliminating their impacts on communities and ecosystems.

SUPPLY CHAIN AND WATERSHED MANAGEMENT

Mandate endorsers seek avenues through which to encourage improved water management among their suppliers and public water managers alike.

COLLECTIVE ACTION

Mandate endorsers look to participate in collective efforts with civil society, intergovernmental organizations, affected communities, and other businesses to advance water sustainability.

PUBLIC POLICY

Mandate endorsers seek ways to facilitate the development and implementation of sustainable, equitable, and coherent water policy and regulatory frameworks.

COMMUNITY ENGAGEMENT

Mandate endorsers seek ways to improve community water efficiency, protect watersheds, and increase access to water services as a way of promoting sustainable water management and reducing risks.

TRANSPARENCY

Mandate endorsers are committed to transparency and disclosure in order to hold themselves accountable and meet the expectations of their stakeholders.