The Nature Conservancy

The Power of Policy

Creating the conditions to scale nature-based solutions for water security

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Contents

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Acronyms and Definitions

Adaptive Planning	A strategic approach to water management that prioritises flexibility, learning, and responsiveness to changing conditions, uncertainties, and new information.
Analytical Framework	The structured organisation of learnings presented in this study designed to enable users to evaluate *Policy Design Conditions* that exists in their geographies of interest.
CAPEX	**Capital Expenditure:** Initial/upfront costs for project investment and delivery (equipment, land, materials). Contrasted with *OPEX*.
Catchment Management	Planning and management of water resources (quality and quantity) at watershed/ catchment scale: Integrates land use, water quality, and ecosystem health.
CBA	**Cost-Benefit Analysis:** Method for evaluating benefits and costs of a planned action(s) often used when making investment decisions.
Common Execution Conditions	Used in this report to mean conditions that fall outside of the definition of *Policy Design Conditions* but have a material impact on how readily NbS can be implemented. These include technical capabilities and social capital.
Cost Recovery	Mechanisms for recovering investment/maintenance costs for investment in water and sanitation service provision.
Enabling Condition	Used in this report to refer to a condition that has a positive influence on the ability to deliver Nature based Solutions. This includes *Policy Design Conditions* and *Common Executing Conditions*.
ESG	**Environmental, Social, and Governance:** Criteria for project classification and sustainable investment.
Finance	Finance refers to the mechanisms and instruments used to raise and manage money for water sector investments—how money is mobilized and structured.
Funding	Funding refers to the source of money used to pay for water-related projects, services, or infrastructure.
Green Infrastructure	Also sometimes called natural infrastructure, or engineering with nature; intentionally and strategically preserves, enhances, or restores elements of a natural system, such as forests, agricultural land, floodplains, wetlands, coastal forests (such as mangroves), and riparian areas, among others. In some places, green infrastructure is more closely related to stormwater management infrastructure. In this report it is used to refer to a broader family of NbS.
Grey Infrastructure	Built structures and mechanical equipment, such as reservoirs, embankments, pipes, pumps, water treatment plants, and canals. These engineered solutions are embedded within watersheds or coastal ecosystems whose hydrological and environmental attributes profoundly affect the performance of the grey infrastructure.[1]
ICW	**Integrated Constructed Wetlands:** A wetland designed to treat wastewater and/or surface runoff while delivering wider benefits to wildlife and people.
Institutional Arrangements	The organisation of decision-making impacting water management and NbS delivery: These cover a range of geographic/political scales and cut across sectors.
Laws	The primary legislation (constitution, or national and subnational Acts/Laws) that provides the framework within which Government, regulation, water and sanitation service provision, land management and other institutions and sectors involved in delivering NbS for water security are structured and act

1 Browder, G., Ozment, S., Bescos, I.R., Gartner, T., & Lange, G.-M. (2019, January). *Integrating Green and Gray: Creating next generation infrastructure.* World Research Institute. https://doi.org/10.46830/wrirpt.18.00028.

NbS	**Nature-based Solutions:** Solutions leveraging nature and healthy ecosystems for water security. Uses IUCN definition.
OPEX	**Operational Expenditures:** Costs for maintaining and operating project components (maintenance, labour). Used in conjunction with CAPEX.
Outcome-Based Regulation	Regulations emphasising objectives (e.g., environmental or drinking water quality): Rather than prescribing adoption of specific technologies or end of pipe emission limits.
PES	**Payment for Ecosystem Services:** Schemes compensating landowners/managers for ecosystem services benefiting water users.
Policy	The guidance and strategic direction that shape how legislation is implemented, priorities are set, and decisions are made by regulators, water and sanitation service providers, and other stakeholders—under the authority granted by laws and secondary legislation.
Policy Design Conditions	Used in this report to mean intentional features of *laws, regulation, policy, funding, finance, institutional arrangements* that have an impact on water management and NbS deployment.
Regulation	The framework of standards, oversight, and enforcement mechanisms implemented through powers granted by laws and secondary legislation
Social Capital	Used in this report to refer to cultural norms, leadership and trust as it relates to delivery of NbS.
Technical Capabilities	Used in this report to cover skills and systems that support NbS delivery and innovation.
Totex	**Total Expenditure:** Combines capital and operational expenditures to avoid bias towards grey infrastructure.
Water and Sanitation Service Providers	Entities responsible for providing, servicing, and maintaining (under legal mandate or otherwise) water and sanitation services in a specific area. They may be public, private or exist under other structures,
Water Security	The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability.[2]
WSSP	**Water and Sanitation Service Providers:** Organisations responsible for water and sanitation services in a specific area (public or private).

2 Browder, G., Ozment, S., Bescos, I.R., Gartner, T., & Lange, G.-M. (2019, January). *Integrating Green and Gray: Creating next generation infrastructure.* World Research Institute. https://doi.org/10.46830/wrirpt.18.00028.

Organisational Acronyms

ACRONYM	FULL NAME (ORIGINAL LANGUAGE)	FUNCTION/ROLE
ADB	Asian Development Bank	Multilateral development bank
AFD	Agence Française de Développement	French Development Agency
ANA (Brazil)	Agência Nacional de Águas e Saneamento Básico	National Water and Sanitation Agency
ANA (Peru)	Autoridad Nacional del Agua	National Water Authority
ANB	Agentschap voor Natuur en Bos	Agency for Nature and Forests, Belgium
ARSAEMG	Agência Reguladora de Serviços de Abastecimento de Água e de Esgotamento Sanitário de Minas Gerais	Local water/sanitation regulator, Brazil
ARUP	Arup Group Limited	Global engineering and consulting firm
BLM	Bureau of Land Management	US federal agency
CAGECE	Companhia de Água e Esgoto do Ceará	Ceará Water and Sewage Company, Brazil
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza	Tropical Agricultural Research and Higher Education Center
CENTA	Centro de Nuevas Tecnologías del Agua	Spanish water technology research foundation
CNRH	Conselho Nacional de Recursos Hídricos	National Water Resources Council, Brazil
COGERH	Companhia de Gestão dos Recursos Hídricos	Ceará Water Resources Management Company, Brazil
CONAMA	Conselho Nacional do Meio Ambiente	National Environment Council, Brazil
COPASA	Companhia de Saneamento de Minas Gerais	Minas Gerais Sanitation Company, Brazil
CPHEEO	Central Public Health and Environmental Engineering Organisation	Indian government agency, sets standards for water/sanitation infrastructure
EMASA	Empresa Municipal de Água e Saneamento Ambiental	Municipal water company, Brazil
EMBASA	Empresa Baiana de Águas e Saneamento	Bahia Water and Sanitation Company, Brazil
EPA (Denmark	Environmental Protection Agency	National environmental regulator
EPA (Ireland)	Environmental Protection Agency	National environmental regulator
EPA (USA)	Environmental Protection Agency	Federal environmental regulator
EPS	Empresas Prestadoras de Servicios	Water and sanitation service providers, Peru
EPSAR	Entidad Pública de Saneamiento de Aguas Residuales	Public Entity for Wastewater Sanitation, Spain
Eldowas	Eldoret Water and Sanitation Company	Water utility, Kenya, case study partner
FNMA	Fundo Nacional do Meio Ambiente	Brazilian National Environment Fund
GEF	Global Environment Facility	International funding partner
GEMMA	Group of Environmental Engineering and Microbiology	Spanish environmental engineering research group

ACRONYM	FULL NAME (ORIGINAL LANGUAGE)	FUNCTION/ROLE
ICTA-UAB	Institute of Environmental Science and Technology, Universitat Autònoma de Barcelona	Spanish university research institute
IIAMA	Instituto de Ingeniería del Agua y Medio Ambiente	Spanish water engineering research institute
IVL	IVL Svenska Miljöinstitutet	Swedish Environmental Research Institute
IWA	International Water Association	Global network for water professionals
MERESE	Mecanismos de Retribución por Servicios Ecosistémicos	Ecosystem Services Compensation Mechanism, Peru
MINAM	Ministerio del Ambiente	Ministry of Environment, Peru
Natuurpunt	Natuurpunt	Belgian environmental NGO, partner in NbS implementation
OECD	Organisation for Economic Co-operation and Development	International policy and research organization
OFB	Office Français de la Biodiversité	French Biodiversity Agency, France
SAGE	Schéma d'Aménagement et de Gestion des Eaux	Water Development and Management Scheme, France
SDAGE	Schéma Directeur d'Aménagement et de Gestion des Eaux	Master Plan for Water Development and Management, France
SHG	Self-Help Group	Informal grassroots collectives in India, key actors in rural NbS implementation
SINGREH	Sistema Nacional de Gerenciamento de Recursos Hídricos	National System for Water Resources Management, Brazil
SIWI	Stockholm International Water Institute	Research and policy institute, project co-lead, expertise in WASH and water governance
SSPD	Superintendencia de Servicios Públicos Domiciliarios	Superintendency of Public Utilities, Colombia
SUNASS	Superintendencia Nacional de Servicios de Saneamiento	National Superintendency of Water and Sanitation, Peru
TNC	The Nature Conservancy	Global NGO focused on conservation
USDA	United States Department of Agriculture	US federal agency,
VEI	Vitens Evides International	Dutch water operator
VLM	Vlaamse Landmaatschappij	Flanders Land Agency, Belgium
VMM	Vlaamse Milieumaatschappij	Flanders Environment Agency, Belgium
Veolia	Veolia Environnement S.A.	French transnational company
WRUA	Water Resource Users Association	Local water user group, Kenya
World Bank	World Bank Group	Multilateral development bank

Foreword

Frank Rijsberman
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Water is life. It nourishes our bodies, sustains our ecosystems, and underpins every facet of human development. In fact, the very ubiquity of water means that for too long we've taken it for granted. And now we stand at the crossroads of dual planetary crises: a rapidly changing climate and accelerating biodiversity loss, both of which are impacting water availability and freshwater ecosystem health. It is in this context that our freshwater systems, rich and fragile, are quickly declining. These challenges are not distant or abstract; they are immediate, tangible, and disproportionately impact the most basic services we rely on: water and sanitation. Put simply, our watersheds demand urgent, innovative, and adaptive action.

Nature-based solutions (NbS), defined as specific actions to protect, manage, and restore natural and modified ecosystems to address societal challenges, can be valuable tools for addressing the planet's water crisis. By strategically investing in nature through actions like wetland restoration, reforestation, riparian protection, and sustainable agricultural and ranching practices, we can enhance water security, improve sanitation outcomes and build resilience in the face of climate shocks. And we can do it all while protecting and restoring biodiversity at the same time.

But unlocking the full potential of nature for water security requires more than technical know-how; it demands a fundamental shift in how we govern and regulate watersheds and water and sanitation services. This report, *The Power of Policy*, supports that shift by offering an analytical framework to guide users in finding the strengths and weaknesses in the policy conditions where they work and, crucially, provides real world insights that can shape reform.

The report also demonstrates that, just as informal initiatives may fail to gain scale without the necessary enabling laws and regulations, even the most well-crafted policies can falter without attention to the local context. Geography, culture, governance capacity, and social dynamics all shape the success or failure of implementation. As such, the findings underscore the importance of tailoring enabling policies to the realities on the ground. In doing so, it reinforces the vital role that **partnerships and collaboration can play in helping us make this shift**.

Where diverse actors (governments, utilities, Indigenous peoples, NGOs, local communities, and the private sector) come together with a shared purpose, we see the most promising examples of enabling conditions translating into real-world impact. These alliances are not just helpful; they are essential. They bridge the gap between policy and practice, aligning incentives, resources, and local knowledge to overcome barriers that no single actor could tackle alone.

As we chart a course toward more sustainable and resilient water and sanitation systems, this report offers both a call to action and a roadmap for how policy makers and practitioners can get there—**together**.

Frank Rijsberman
Kent Thiry and Denise O'Leary Head of Policy and Public Funding

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Executive Summary

The Power of Policy: Creating the conditions to scale nature-based solutions for water security

Purpose of the study

Across the globe, water security is under threat. Climate change and watershed degradation are driving up costs and increasing the frequency of disruptions for water users—impacts that are hitting the world's most vulnerable communities hardest. These same forces are contributing to unprecedented habitat destruction and biodiversity collapse.

Nature-Based Solutions (NbS) such as wetland restoration, reforestation, riparian protection, and sustainable agricultural are proven to help address these acute water challenges as they deliver resilient, lower-cost water and sanitation services, extend the service life of traditional grey infrastructure and support thriving biodiversity and communities.

The good news is that investments in NbS for water are gaining important momentum. In fact, investments doubled over the past decade, reaching USD 49 billion in 2023.[3] But while some countries and regions appear to be embracing the approach, uptake remains remarkably uneven.

This disparity in uptake raises a number of questions for decision makers, including: what is the role of policy in mainstreaming investments in NbS at a watershed scale? And what enabling conditions are necessary to succeed?

The Power of Policy aims to answer these questions and, in doing so, help policy makers deliver targeted reforms that will accelerate NbS delivery for the benefit of people and nature.

3 *Doubling Down on Nature: State of Investment in Nature-based Solutions for Water Security*.

Key findings

This research distils insights from existing literature, 17 original country case studies, and over 75 expert interviews. The selection of case studies captures the wide range of political, legal, and economic contexts in which NbS for water investment are delivered today. While every case study has unique legal, policy, cultural and economic context, key themes did emerge:

1. **What legal frameworks enable, permitting can undermine.** Where NbS are integrated into water laws, land-use policies, and environmental regulations, they open pathways for investment in ecosystem-based approaches. However, permitting regimes, options appraisals and financing conditions that originate from regulation of grey infrastructure often preclude or disadvantage consideration of NbS. Enabling policies for NbS include:
    a. ***Regulations that accommodate variability in NbS performance***, were identified as a key enabler that was cited in many case studies including China and Ireland.
    b. ***Economic assessment*** that captures the value NbS create beyond the narrowly defined water security benefits can support case for selecting NbS over grey infrastructure. This was observed in recent guidance to water utilities in the England, while narrow definitions of value in regulatory system were cited as problematic in our Spanish case study.
    c. ***Financial regulation*** often has an unintended bias towards debt financing of grey infrastructure, but good practice does exist. For example, the *Room for the River* case study (Netherlands) illustrates how whole life cost analysis can favour NbS, while Ofwat, the water regulator in England & Wales was seen to be making moves to explicitly address the bias towards Capital expenditure that favours NbS.

2. **Coordination between institutions and across jurisdictions is key.** Unlike most grey infrastructure projects, delivery of NbS cuts across multiple sectors (agriculture, water, urban planning) and spans jurisdictions from national decision makers all the way down to individual farmers. As a result, enabling policies to delivery of NbS at scale requires:
    a. ***Coordination between institutional arrangements* for water and land use (and sometime environmental protection).** Colombia provides a good example of institutional design with mechanisms to facilitate dialog and promote consensus decision-making in the use, management, and conservation of water resources.
    b. ***Coordination across jurisdictions*, especially between upstream and downstream parties.** For example, countries with robust watershed-level planning, like France and Brazil, demonstrate how multi-level coordination and inclusive platforms enable long-term investment.

3. **Policy cannot be implemented without financing: predictable revenue and impartial procurement are vital.** NbS programs often struggle to secure stable revenue sources beyond feasibility and early implementation stages. Enabling policies should extend to revenue models:
    a. ***Grants and concessional loans*** can help de-risk project preparation, while tariff-based models, blended finance, and payment for ecosystem services can provide stable revenue that transcends political cycles. In Belgium, a coalition of NGOs and utilities accessed a variety of regional and European grant programs to support early-stage NbS programs, while in Brazil and Peru specific provisions support inclusion of NbS in tariffs.
    b. ***Procurement processes and funding rules*** must make funding attractive to delivery partners, e.g., NGOs, landowners and community groups. For example: Brazil's decentralized funding and public-private partnerships are a standout example of good practice.

4. **Community support, leadership and capacity are key—whatever the policy conditions.** Enabling policy that unlocks funding alone doesn't lead to scale if there is a lack of technical capacity, trust or community support.
    a. ***Committed individuals, institutional leadership, and local collaboration*** are key, especially where policy support for NbS is weak or missing. For example, in the US, a novel agreement between the Jicarilla Apache Nation and the State of New Mexico, built on intensive negotiations, collaboration and trust, enabled NbS deployment without new legislation being passed.
    b. ***Political commitment to build capacity can bolster robust legislation and deter noncompliance.*** For example: In Chile, while there are many barriers, one new law and a commitment to meeting Nationally Determined Contributions (NDC) have allowed for NbS investment and advancement.

5. **Crises Create Windows of Opportunity—but a rapid response is needed to capitalize.** Extreme weather events that disrupt water service can catalyse a rapid uptake of NbS. Success, however, depends on institutional readiness and the ability to bring shovel-ready projects to decision makers
    a. For example, South Africa's 2018 drought crisis catalysed accelerated investment in NbS as part of its water resilience strategy.
    b. Repeated catastrophic flooding in the Netherlands led to technical and political support for the radical new concept of making Room for the River—unlocking huge investment in floodplain reconnection.

From analysis to action

The findings of the case studies underscore the fact that policies driving investment in water security are embedded in political, legal, financial, and social systems—each offering a unique set of opportunities and barriers for NbS deployment. As such, the study doesn't propose a one-size-fits-all set of reforms for policy makers to adopt. Rather, for the first time, it captures a comprehensive set of enabling conditions based on real-world experience and distils these findings into an **analytical framework (**Annex 2**)**. This framework is a tool to support policy makers in understanding where policies are enabling or inhibiting NbS adoption where they work, and with insights from case studies and broader findings, design actionable and locally targeted reforms to enable investment in NbS.

In designing those reforms, it is important to note that perfect enabling policies are not a pre-condition to adopting NbS at a watershed-scale. Indeed, the 17 cases studied illustrate how leadership, trust, and a willingness to innovate can overcome barriers to NbS. Often this comes down to exceptional individuals willing to take risks and the ability to build coalitions that can deliver.

But reliance on exceptional individuals is not a viable strategy for bridging the gap between early adoption and mainstream acceptance of NbS for water security. We need governments to legislate with intent, regulators to rethink incentives, water and sanitation service providers to build NbS into their investment programs, and communities to be engaged in co-creating solutions. Policy makers eager to meet this challenge will find in this study the basic ingredients and tools to do so.

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Introduction

Why enabling policies for Nature based Solutions matter

Climate change, population growth, unsustainable catchment management, and pollution are eroding water security across the world, increasing costs to water users and amplifying the risk of disruption to water services. These pressures on water security are also devastating biodiversity in source watersheds, accelerating habitat loss and ecosystem decline.

Against this backdrop, Nature based Solutions (NbS) for water security have emerged as a powerful approach to tackle the intertwined challenges of water insecurity and biodiversity loss. By protecting, sustainably managing, and restoring ecosystems, NbS deliver essential water-related benefits, complementing built infrastructure to reduce operational costs, enhance resilience, and generate broader social and economic gains.[4]

There is evidence that NbS for water security are gaining traction, with investment nearly doubling in the past 10 years to reach USD 49 billion in 2023.[5] While national governments lead investment in NbS for water security, we see increasing investment by local water users, with this group nearly tripling investment in NbS over the last decade. Water and sanitation service providers are key actors within this group and often play an anchor role at the watershed scale, driving investment in NbS, including through collective action mechanisms. This welcome growth masks wide regional disparities, with China accounting for nearly half of all spending while Europe and the United States make most of the rest of investments. This raises the question: *Why have some countries and regions been more successful in driving investment in NbS?*

Finance and institutional arrangements play a key role in enabling implementation. For example the report *Doubling Down on Nature: State of Investment in Nature-based Solutions for Water Security*[6] underscores the importance of strengthening policy and planning to deliver long-term impact while Investing in Nature for Europe's Water Security[7] identifies regulatory barriers as a key constraint on NbS investment.

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4 Browder, G., Ozment, S., Bescos, I.R., Gartner, T., & Lange, G.-M. (2019, January). *Integrating Green and Gray: Creating next generation infrastructure.* World Research Institute. https://doi.org/10.46830/wrirpt.18.00028.

5 *Doubling Down on Nature State of Investment in Nature-based Solutions for Water Security.* (2025). https://www.nature.org/content/dam/tnc/nature/en/documents/d/o/Doubling_Down_on_Nature_State_of_NBS_2025.pdf.

6 Ibid.

7 Tremolet, S., Favero, A., Karres, N., Toledo, M., Kampa, E., Lago, M., Anzaldua, G., Vidaurre, R., Tarpe, J., Makropoulos, C., Lykou, A., Hanania, S., Rebollo, V., & Anton, B. (2019). Investing in Nature for European Water Security [Review of *Investing in Nature for European Water Security*]. In S. Parker, K. Vazquez Mendoza, & A. Guzman (Eds.), nature.org. The Nature Conservancy. https://www.nature.org/content/dam/tnc/nature/en/documents/Investing_in_Nature_for_European_Water_Security.pdf.

In Sub-Saharan Africa, *Growing Resilience: Unlocking the Potential of Nature-Based Solutions for Climate Resilience*[8] identifies integration of NbS into national and subnational policies and plans as the highest priority for accelerating rollout and scale while *Financing Climate Adaptation and Nature-Based Infrastructure*[9] argues that policy, regulation, and planning are indispensable tools for creating incentives for NbS investment.

This report builds on these findings—providing tools to help policymakers and practitioners diagnose where reforms to enable NbS investment are most needed in their national or local context, while offering real-world examples enabling policy illustrating what good can look like. In doing so it empowers stakeholders to take the leap from analysis to action by clarifying pathways for change that can unlock the full potential of NbS.

Objective of the study

This study was conducted to assess the specific question of what features of ***Policy Design***—including the laws, regulations, policy, funding and finance, and institutional arrangements enable water and sanitation service providers to invest in NbS.

The findings draw directly on lessons learned from case studies and are intended to offer practical insights for governments, regulators, and water and sanitation service providers looking to promote NbS investment for water security.

The comparative analysis of case studies shaped an analytical framework that can be used to assess the suitability of Policy Design for NbS adoption by water and sanitation service providers. The framework is intended to serve as a tool to facilitate multi-stakeholder dialogue to assess current NbS enablers and barriers and prioritize actions that unlock more NbS investment. Considering the limitations of a globally applicable methodology, the framework aims to account for the complexity of local conditions in a way that can be implemented effectively with a reasonable investment in time and resources.

How NbS support water and sanitation service providers

There is extensive literature[10] on the benefits of NbS and their role in addressing water security challenges. In this study, we have focused specifically on the role of NbS in delivering against the primary functions of water and sanitation service providers, often implemented by separate parts of these organizations, namely the **provision of drinking water**, the **treatment of wastewater**, and the **management of stormwater**.[11]

8 Collins, N., van Zanten, B., Onah, I., Marsters, L., Jungman, L., Hunter, R., von Turkovich, N., Anderson, J., Vidad, G., Gartner, T., & Jongman, B. (2025, February 19). *Growing Resilience: Unlocking the potential of Nature-based Solutions for climate resilience in Sub-Saharan Africa*. World Research Institute. https://doi.org/10.46830/wrirpt.22.00159.

9 *Financing Climate Adaptation and Nature-Based Infrastructure.* (2025, May 14). World Bank.

10 See for instance:
- *The United Nations World Water Development Report 2018: Nature-based solutions for water.* (2018). United Nations Educational, Scientific and Cultural Organization (UNESCO). UN-Water. Retrieved from https://www.unwater.org/publications/world-water-development-report-2018.
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11 The remits and responsibilities will differ between water and sanitation service providers in different jurisdictions, and there may be interdependencies—for example, surface water management contributing to water resource aquifer recharge that supports provision of drinking water.

Previous work at The Nature Conservancy[12] identified categories for NbS that serve water security objectives and provide multiple co-benefits. Some NbS could fall into multiple categories, depending on scale and context. The four categories included are:

i) **Habitat 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, such as floodplains and riparian area conservation.

ii) **Habitat restoration:** an active or passive intervention that involves returning degraded, damaged, or destroyed ecosystems to pre-disturbance state, or as close as possible. Considered synonymous with reclamation, reforestation, rehabilitation, revegetation and reconstruction, dam removals, or reconnection of floodplains and wetlands to river systems.

iii) **Best Land Management Practices:** natural resource management approaches other than restoration or protection for fire management, forestry, and agriculture. Examples include regenerative agriculture, grazing management, prescribed burning, and tree thinning.

iv) **Creation of artificial habitats:** interventions involving the establishment of artificial ecosystems. This includes non-natural tree stands, artificial grasslands, created wetlands (not restored).

For the purposes of this study, these categories have been recast against the *functions* of a water and sanitation service provider (see above) and categorized as being either **end-of-pipe**, meaning interventions where they form part of sewerage network or water and sanitation service provider operational site, or in **watershed/catchment management**, where NbS are typically deployed outside a water and sanitation service provider's grey infrastructure asset base. This distinction is made as the enablers and barriers that apply to NbS requiring interventions in land and water systems dispersed across the watershed/catchment may be very different to those that are integrated into conventional assets. While disaster risk was not included in the scope of this study, all of the NbS in Table 1 could be deployed as disaster risk prevention in the right context.

The resultant classification scheme (Table 1) was used to provide a consistent approach for recording how NbS were deployed by water and sanitation service providers in each case study set out in Case Studies.[13]

12 *Financing Nature for Water Security: A How-to Guide to Develop Watershed Investment Programs – Factsheets of nature-based solutions for water security.* (n.d.) The Nature Conservancy and AFD. https://resilientwatershedstoolbox.org/.

13 Out of the 17 case studies, 14 refer to cases having water resources as primary objectives, and three refer to cases having wastewater management as primary objective. The scope of the case studies did not extend to surface water management.

TABLE 1 : Classification scheme NbS for water and sanitation service providers

DWSSP Functions	Typical Objective of NbS		Watershed vs. End-of-Pipe	Primary NbS Categories	Examples
Drinking Water Supply	Protecting/increasing deployable output and/or reducing impact of water withdrawals from the environment.	Water Quantity	Catchment/ Watershed	Habitat protection Habitat restoration Land management	**Protection** of native vegetation in drinking water catchment. **Restoration** of habitats by removing invasive non-native species that have high evapotranspiration. Supporting regenerative agriculture **management** to reduce sediment and pesticide loads on drinking water sources.
	Reducing pollution risk/treatment cost for drinking water supplies.	Water Quality			
Wastewater Services	Offsetting or mitigating wastewater impacts on environment	Water Quality			
	Wastewater treatment—standalone or in combination with conventional processes	Water Quality	End-of-Pipe	Artificial habitat creation	**Creation** of treatment wetlands either as polishing of treated effluent or as standalone sanitation solution.
Surface Water Management	Reducing volume of surface water runoff into sewer and drainage network	Water Quantity	Catchment/ Watershed	Artificial habitat creation Land management	**Creation** of detention ponds swales and other Sustainable Urban Drainage features **management** of urban green spaces to enhance infiltration and minimize risk of sediment / pollution transport.
	Improving quality of surface water runoff before entering the environment	Water Quality	Catchment and End-of-Pipe		

Research Approach

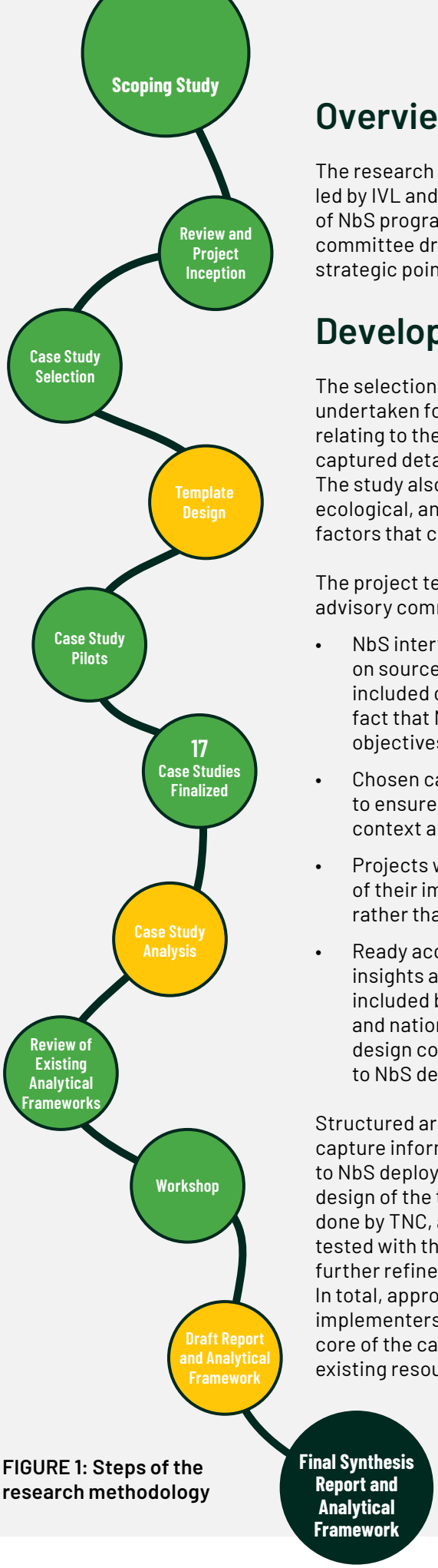


FIGURE 1: Steps of the research methodology

Overview

The research approach adopted for this study is set out in (Figure 1). The work was led by IVL and Arup with support from TNC staff engaged in the policy and practice of NbS program development at a global, regional and local scale. An advisory committee drawn from experts in the domain to provide insights and feedback at strategic points, highlighted in yellow in the project development.

Development of case studies

The selection of case studies was informed by an unpublished scoping study undertaken for TNC. The scoping study reviewed academic and grey literature relating to the deployment of NbS by water and sanitation service providers and captured details of enablers and barriers in Policy Design where they were cited. The study also drew on wider contextual information relating to socio-economic, ecological, and hydrological conditions to provide a rounded overview of key factors that could explain why and how NbS were delivered.

The project team used the scoping study findings and input from TNC staff and advisory committee to shortlist studies that met key selection criteria. These were:

- NbS interventions explicitly address *water security*. While most are focused on source water and wastewater treatment, the scope of some case studies included other water security objectives like flood resilience, reflecting the fact that NbS can be multi-functional and that in some locations water security objectives were inseparable from each other.
- Chosen cases were based on their relevance to national policy design contexts to ensure they reflected broader patterns of NbS implementation in a country's context and not outliers.
- Projects were completed or at an advanced stage, ideally with some evaluation of their impact, to allow findings to be drawn from documented experiences rather than anticipated outcomes.
- Ready access to information and key case study stakeholders willing to share insights and, where possible, supporting documentation. These stakeholders included both individuals with direct knowledge of the selected case studies and national-level experts who could provide insights into national policy design conditions and wider contextual factors that act as enablers or barriers to NbS deployment.

Structured around a fixed template, case studies were designed to systematically capture information about the most significant enabling conditions and barriers to NbS deployment experienced along with important contextual information. The design of the template drew on insights from the scoping study, previous work done by TNC, and inputs from the advisory committee. A draft of the template was tested with three case studies (Colombia, South Africa, and United Kingdom) and further refined before being rolled out to all 17 countries shown on the page 16.
In total, approximately 75 interviews were conducted with project members, implementers, policymakers, and national experts. These interviews formed the core of the case study research process, supplemented by an extensive review of existing resources in each country.

MAP 1: CASE STUDY LOCATIONS

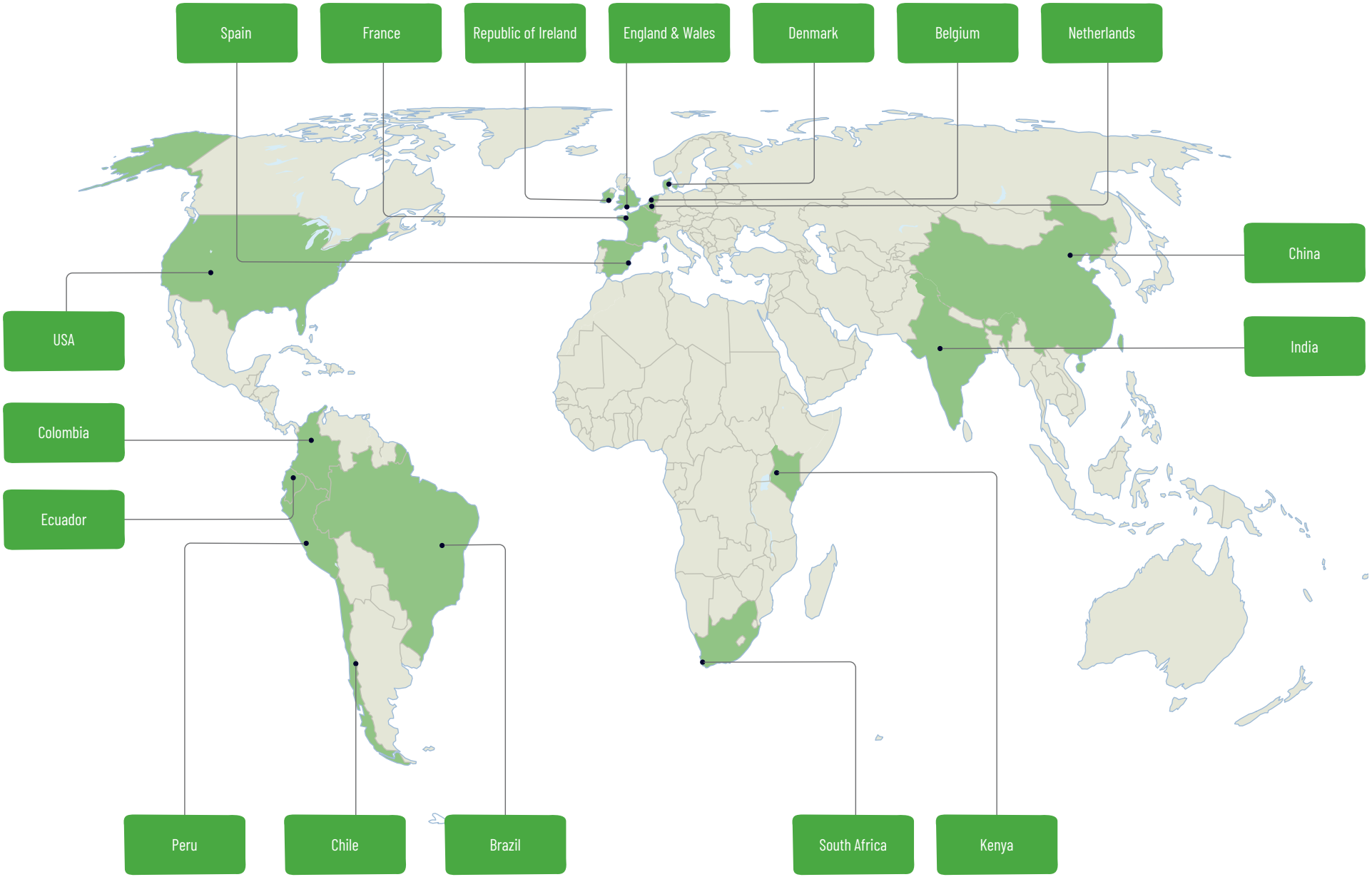


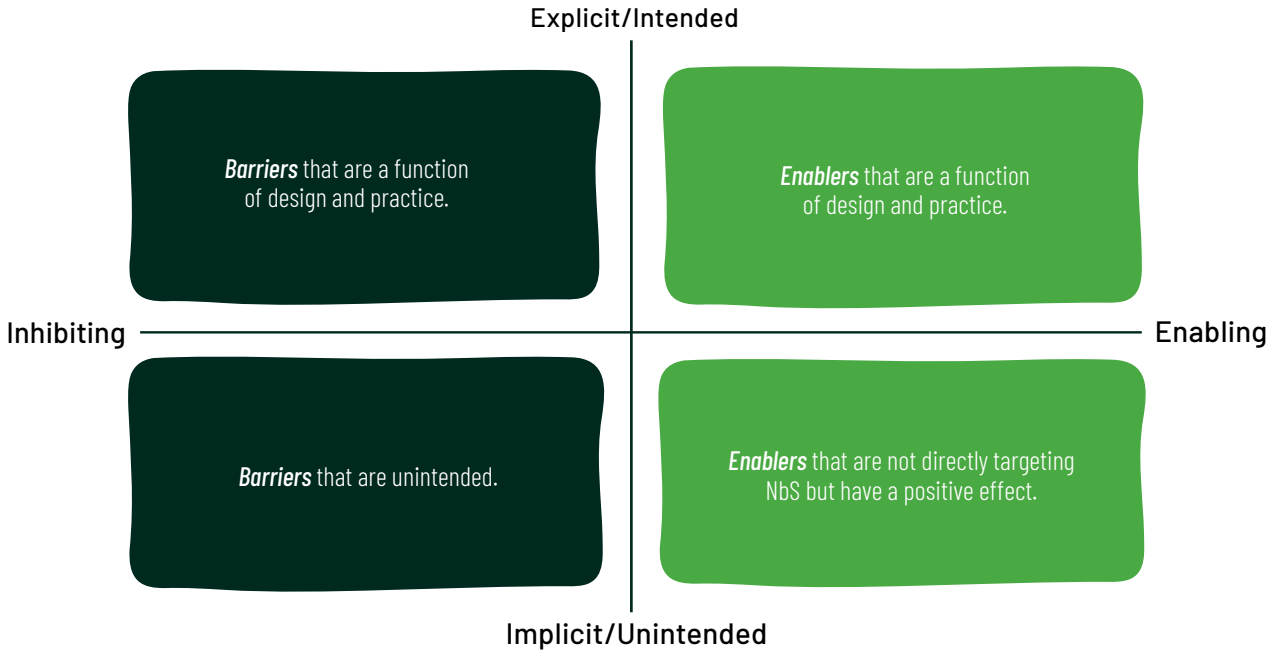
TABLE 2: List of case studies

	NbS Primary Objective				NbS Deployment	
Country	**Drinking Water Quality**	**Drinking Water Quantity**	**Wastewater Quality**	**Surface Water Management**	**Watershed**	**End-of-Pipe**
Belgium		✓			✓	
Brazil			✓			✓
Chile	✓	✓			✓	
China	✓	✓			✓	
Colombia	✓	✓			✓	
Denmark	✓			✓	✓	
Ecuador		✓			✓	
England & Wales			✓		✓	
France		✓			✓	
India		✓			✓	
Kenya	✓	✓			✓	
Netherlands				✓	✓	
Peru		✓			✓	
Republic of Ireland			✓			✓
South Africa		✓			✓	
Spain	✓	✓	✓			✓
United States		✓			✓	

Development and design of analytical framework

The first step for creating the analytical framework was to extract key learning (policy design and contextual) from the case studies that were considered relevant to how readily NbS could be implemented. These key learnings were then placed on a grid where the X axis relates to how *Inhibiting* or *Enabling* they were to NbS adoption, and the Y axis relates to whether they are *Implicit/Unintended* or *Explicit/Intended* features of policy design and water and sanitation service provider practice (see Figure 2). Case study grids were reviewed with common findings collated and clustered (see Case Studies).

FIGURE 2. Grid for categorizing lessons learned from case studies



Through a process of iterative refinement, common enabling conditions were identified, capturing learning about policy design and wider contextual factors that support NbS deployment by water and sanitation service providers. These were then structured into a coherent analytical framework where each enabler was assigned a category, with a description of key characteristics and supporting case studies (see Table 3). This process was informed by existing governance analytical frameworks, including the OECD Water Governance Framework,[14] the City Water Resilience Approach,[15] the IUCN application framework for NbS,[16] the World Bank Worldwide Governance Enabling conditions.[17]

The final analytical framework defines four categories of *Policy Design Conditions*. This term was used to capture the fact that these are features of how systems for water and watershed management that have been intentionally created by policy makers—even if the consequences for NbS are unintentional. We have categorised them as:

- **Laws (Constitutions and Legislation):** The primary framework within which Government, regulation, water and sanitation service provision, land management and other institutions and sectors involved in delivering NbS for water security are structured and act
- **Policies and Regulation:** Including secondary legislation, guidance and directions that shape how legislation is enacted, priorities set, decisions made etc.
- **Finance and Funding:** Specifically focusing on how investment is decided and how money flows .
- **Institutional Arrangements:** How decision-making that has an impact on NbS delivery is organised at different geographic and political scales and across different sectors.

14 *Water governance.* (n.d.). Organisation for Economic Co-operation and Development (OECD). https://www.oecd.org/en/topics/water-governance.html.

15 *City Water Resilience Approach* (CWRA). (2025). Resilient Cities Network. https://resilientcitiesnetwork.org/city-water-resilience-approach/.

16 *Guidance for using the IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of Nature-based Solutions.* (2020). IUCN. https://portals.iucn.org/library/sites/library/files/documents/2020-021-En.pdf.

17 World Bank. (2024). Worldwide Governance Indicators. https://www.worldbank.org/en/publication/worldwide-governance-indicators.

The case studies also captured a range of issues that fell outside the normative conditions established by the ***Policy Design Conditions*** but nonetheless were cited as critical to the success of NbS rollout. A comprehensive survey of these enablers was out of scope of this study but the fact that some common issues were raised repeatedly made them too important to ignore. As a result, they have been captured as ***Common Execution Conditions*** in two categories:

- **Technical capabilities:** The skills and systems that support NbS delivery and innovation.
- **Social capital:** Having cultural norms that support NbS approaches, leadership to drive change and trust between actors.

The classification and categorization of enablers was a key step in developing a workable analytical framework. But in reality, the boundaries between policy design categories—and even between policy design and execution conditions—are not always clearly defined. Most notably, *legislation* functions as the primary starting point for all activities related to how regulators and water and sanitation service providers can operate and therefore influences all *Policy Design Conditions* categories. More broadly enabling conditions for NbS should be understood s a system of interacting elements which is not static but can respond to learning from early adopters and demand for NbS (see Figure 3).

FIGURE 3: Visual Summary of Analytical Framework Structure

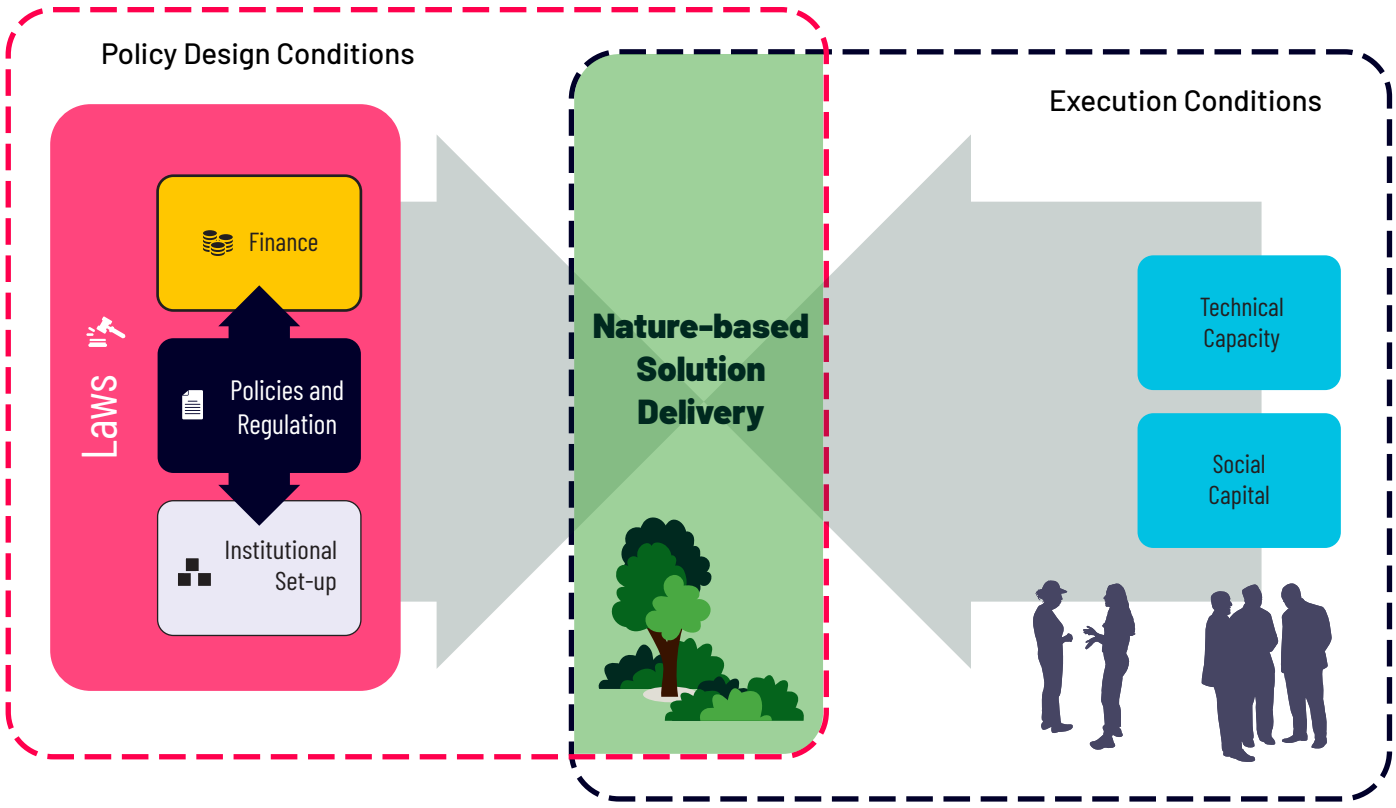


TABLE 3. Analytical Framework structure

Domains	Differentiates between Policy Design Conditions and common Execution Conditions that have been identified as critical for enabling NbS delivery.
Categories	The broad, overarching conceptual categories that represent the key Policy Design Conditions and common Execution Conditions that influence and can scale the successful adoption and scaling of NbS. Each conceptual category is designed to encompass a wide range of factors that are integral to the development and implementation of NbS by water and sanitation service providers. For instance, the "institutional arrangements" category includes enabling conditions related to planning, coordination, and monitoring mandates and participation mechanisms.
Enabling conditions	Enabling conditions are formulated to reflect an optimal situation, that would facilitate adoption of NbS. For example, under the Funding and Finance category, they include, among others, the availability of funding for NbS projects, their accessibility to different stakeholders, or the possibility to develop pooled funding mechanisms. The enabling conditions reflect specific challenges and opportunities of each category, ensuring that they effectively capture the factors that contribute to or hinder the successful adoption of NbS by water and sanitation service providers in various contexts.
Characteristics	Characteristics are provided for each enabling condition, giving a detailed explanation of key elements that would contribute to achieving the ideal enabling condition. The insights offered are intended to help interpret the enabling conditions and what needs to be in place. Key concepts under each explanation are highlighted in bold face.
Case study examples	To provide concrete context and demonstrate where enabling conditions are coming from and how they are met in real-world situations. These examples offer practical insights into how the conceptual categories, enabling conditions, and characteristics work in practice and relate to one another, showcasing both successes and challenges in NbS implementation. They provide valuable lessons, examples of best practices, and highlight barriers, as well, offering concrete examples of the kind of enablers or barriers that an assessment can look out for.

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Findings of the Study

Overview of case study findings

From a policy design perspective, the case study interviews with 75 experts spanning 17 countries highlight a wide range of entry points that have allowed water and sanitation service providers and those with similar mandates or interests to deliver NbS.

For example, because the term NbS is relatively new in policy discussion, water, environmental and land management laws generally do not explicitly incorporate NbS in definitions or objectives unless they have very recently been drafted. But wider principles—such as nature and water conservation, ecological infrastructure or the recognition of certain rights such as the human right to water and sanitation, the right to healthy environment or the rights of nature—align with opportunities NbS offer and provide a robust basis for NbS to be integrated into water and sanitation service providers infrastructure catalogs (e.g., Ecuador, South Africa). More recent climate change laws (e.g., China), climate change strategies (e.g., Chile), and international commitments such as Nationally Determined Contributions, offer more explicit recognition and promotion of NbS, as we saw in almost every country.

Regulations in certain countries have taken steps to incorporate NbS, and develop mechanisms for their adoption, such as the incorporation of NbS related costs in tariffs (e.g., Colombia, Brazil), the development of environmental outcome metrics that would help water and sanitation service providers incorporate NbS (e.g., UK), or the establishment of mechanisms for payment for ecosystems services (e.g., Kenya, Peru, Ecuador, and others). However, a common theme raised in nearly all case studies was lack of comprehensive governance framework and regulatory tools in relation to NbS, with frequent contradictions across different legal, regulatory, and policy instruments.

We also saw evidence of very structured coordination and planning mechanisms for water security down to local level (e.g., Brazil, France, South Africa). This provides a sound basis for enabling NbS, but implementation is not always conducive to delivery.

Funding and Finance are also key barriers. Most countries analyzed have one or more mechanisms that would allow the implementation of some NbS projects. However, the majority have some important gaps: Either they are not long term and tend to be insufficient, they don't cover all phases of program development—particularly pre-feasibility a feasibility (e.g., France)—they do not sufficiently reach local actors or are difficult to access (e.g., Spain). In some cases, it is the private sector that contributes most to the initiatives, in absence of available public funding for NbS (e.g., Chile, India). Public-private partnerships for water conservation, like a water fund, have been observed in many cases as the preferred instrument for implementation of NbS because of the collective action governance (e.g., Ecuador, Chile).

Despite imperfect policy design conditions, case studies showed the importance of collaboration (e.g., United States), the development of innovation ecosystems, and the leadership of very committed individuals and institutions (e.g., Belgium) for the successful promotion and implementation of NbS. This is particularly important in the countries where the NbS are not mainstream and require further demonstration and promotion to capture more adopters. Limitations in capacity at some level, from policy development through to delivery , was highlighted as a weakness in almost every case study analyzed.

Case study learnings captured in the analytical framework

Exploration of the 17 case studies enabled the identification of common threads and key points of analysis associated with each of the categories outlined above. This section presents the enabling conditions to emerge from the comparative analysis.

POLICY DESIGN CONDITIONS

LAWS. Laws provide the primary framework within which government, regulation, water and sanitation service provision, land management, and other institutions and sectors involved in delivering NbS for water security are structured and act.

Within water related laws, our study found laws that enabling NbS have provisions that:

- Provide a structured approach to sustainable water management that facilitates adequate resource allocation to people, industry, and ecosystems
- Clearly define roles and responsibilities for water management at various governance levels
- Mandate (not just allow for, or worse, prohibit) water and sanitation services providers to protect water resources at source and include provisions for climate adaptation and resilience planning

Land use laws also play a vital role in enabling NbS. Key enabling features captured in the study include:

- Incorporation of nature conservation goals, which promote the use of NbS
- Adoption of key principles of integrated catchment management that facilitates collaboration between landowners and basin authorities

Laws, to a greater or lesser extent, also define funding rules within which regulators and water and sanitation service providers, land managers, and others operate. Enabling conditions for NbS funding include:

- Flexibility in how core function of water and sanitation service providers are regulated and delivered so that NbS and other innovations can be accommodated alongside conventional infrastructure approaches
- Ability to provide grants for NbS project preparation
- Cost recovery for NbS investment and maintenance through tariffs, or other financial mechanisms
- Establishing markets for ecosystem services that generate revenues that support NbS deployment like carbon credits, biodiversity offsets, and water quality trading systems

The importance of *coherence* in objectives, terminology, definitions, and tools across laws governing land, water, and urban planning, among others, was a recurring theme in case studies—reflecting the fact that NbS implementation requires collaboration and coordination between a wide range of actors.

An example of enabling legislation in South Africa

The Constitution of the Republic of South Africa Act, 1996[18], is the primary normative enabler legislation for NbS. It establishes various fundamental human rights that must be protected and fulfilled by the state and regulates the conduct of municipalities, including the supply of essential services. The National Water Act (1998) recognizes water as a public resource and mandates sustainable management practices.

The National Environmental Management Act (1998)[19] and National Environmental Management: Biodiversity Act (2004)[20] explicitly require municipalities and landowners to control invasive species. The Water Services Act 108 (1997)[21] defines maintenance of "water services work" narrowly, but when read with the duties imposed on water services authorities this is broad enough to include ecological infrastructure maintenance by water and sanitation service providers.

This allows for the investment in maintenance of source water catchments outside the City of Cape Town's jurisdiction. Despite these legal provisions, implementation challenges arise when municipalities lack jurisdiction over catchments beyond their boundaries. Inter-municipal agreements remain a bureaucratic hurdle, delaying Alien and Invasive Plant (AIP) clearing efforts.

POLICIES AND REGULATION. Policies and Regulation have a profound impact on how water and sanitation service providers operate, including how readily they can consider and adopt NbS.

We found *international agreements and commitments* can promote adoption of NbS for water security nationally. Frameworks, such as the Sendai Framework, and conventions, like the Ramsar Convention and the Paris Agreement, give weight to implementation of NbS. Where these are given force in national policies and regulations, they can strengthen domestic delivery. But to be effective, such alignment requires clear targets, timelines, and monitoring mechanisms that track progress.

At a national scale, policies and regulations play a fundamental role in shaping water security and environmental objectives, the planning and delivery of investment in water security, and the permitting of land use change, wastewater emissions, and water withdrawals. The case studies illustrated a range of enabling conditions for NbS, as well as policies and regulations that introduced barriers, often unintentionally. From these we found that enabling policies and regulations for NbS at a national scale include:

- A focus on long-term performance goals that allow for establishment and variability inherent in ecosystems
- Outcome-based regulations (i.e., those displayed in Table 1), which emphasize objectives being sought for drinking water, ecosystems, and the wider benefits NbS offer, rather than specifying specific technologies and or emission limits that are not linked to local environmental objectives
- Applying comprehensive cost-benefit analysis (CBA) in strategy and investment evaluations to ensure that wider benefits of NbS are captured when making investment decisions
- Enabling and encouraging cross-sector collaboration and innovation
- Avoiding capital expenditure (CAPEX) bias in economic regulation to avoid favoring grey infrastructure that tends to require significant up-front investment over NbS that often include annual operational expenditure (OPEX) e.g., payments to farmers and land managers, monitoring and evaluation, protected area management
- Designing flexible permitting and compliance regimes that allow for consideration of the inherent variability and impact of environmental factors on NbS performance. This is vital to de-risk innovation, e.g., by allowing scope for experimentation, pilot programs, and phased compliance, ensuring that NbS are not unfairly disadvantaged.

18 Official website of the Constitution of the Republic of South Africa, 1996: https://www.gov.za/documents/constitution/constitution-republic-south-africa-1996-04-feb-1997.

19 *National Environmental Management Act 107 of 1998.* (2023, June 30). South African Government. https://www.gov.za/documents/national-environmental-management-act.

20 *National Environmental Management: Biodiversity Act 10 of 2004.* South African Government. (2023, June 30). https://www.gov.za/documents/national-environmental-management-biodiversity-act-0.

21 *Water Services Act 108 of 1997.* (1997). South African Government (1997).

An example of enabling Policy and Regulation in England

In England, the economic regulator of the water and sanitation sector (Ofwat) set out its position on catchment NbS, "From catchment to customer," in 2011,[22] supporting the Poole Harbour program and others by enabling the funding. Ofwat has recently become more explicit in calling for water companies to consider and implement NbS. In the most recent 5-yearly Price Review[23] ("PR24"), the Final Methodology[24] called for "*a step change increase in the use of nature based rather than traditional solutions*" because of the potential to control costs for large environment improvement program and deliver wider benefits to customers.

The Environment Agency (the environmental regulator) has also become explicit in calling for "a clear commitment to pursue C&NBS [catchment and nature-based solutions] wherever they can deliver all or part of the required environmental outcome," and has provided tools such as "environmental outcome metrics" to support this.

Similarly, for PR24 (the regulated price review) the government provided strategic policy guidance that: "Water companies are expected to adopt NbS as much as possible." Other than encouragement, the primary way in which regulators are trying to facilitate the adoption of NbS is to move away from explicitly prioritizing lowest cost solutions toward the incorporation of Natural Capital Accounting measures or "Best Value" approaches that incorporate wider outcomes and benefits (such as carbon, biodiversity, amenity) while still applying affordability considerations.

Despite these developments, the adoption of catchment and NbS has yet to reach its full potential, and that other aspects of policy and regulation (such as inflexible permitting) hinder adoption at scale. Ofwat has funded an innovation program called "Mainstreaming NbS"[25] to help address this.

FUNDING AND FINANCE. Adequate, predictable funding is critical to the successful implementation of NbS. While experience demonstrates grants and philanthropy can be important in the early stages of NbS program development, delivery at scale requires long-term financial stability that transcends political cycles and short-term grants. The case studies illustrate that water tariffs can provide such predictable funding, but cost-recovery for NbS is not always allowed due to legal, regulatory, or policy constraints.

Mechanisms are also necessary for efficient funding allocation vertically—across government scales (national to local)—and horizontally—across government functions. This is particularly important for NbS because delivery often crosses multiple facets of government responsibility (e.g., water, land, environment) and because watershed scale investment typically involves multiple regional and local government jurisdictions. As a result, it is critical that Funding and Finance rules, and *Institutional Arrangements* (see below) enable budgetary coordination, intergovernmental fiscal transfers, and co-financing agreements that ensure that funds flow smoothly from national to local levels and between different sectoral government authorities.

Financial allocations also need to be inclusive and equitable, ensuring that funding is accessible to diverse stakeholders that can be involved in NbS programs, including local communities, water and sanitation service providers, and NGOs.

Within these structural enabling Funding and Finance conditions, we observed a range of practices that supported NbS adoption including:

- Funding for all stages of NbS program development from feasibility through to execution. Performance-based grants and matching funds to support local authorities in implementing NbS projects.

22 *From Catchment to Customer: Can upstream catchment management deliver a better deal for water customers and the environment?* (2011, September). Water today, water tomorrow. Ofwat. https://www.ofwat.gov.uk/wp-content/uploads/2015/11/prs_inf_catchment.pdf.

23 *Price Reviews.* (2025). Ofwat. https://www.ofwat.gov.uk/regulated-companies/price-review/.

24 *Creating tomorrow, together: Our final methodology for PR24.* (2022, December). Ofwat. https://www.ofwat.gov.uk/wp-content/uploads/2022/12/PR24_final_methodology_main_document.pdf.

25 *Mainstreaming nature-based solutions to deliver greater value.* (2028, September). Ofwat. https://waterinnovation.challenges.org/winners/mainstreaming-nature-based-solutions/.

- Dedicated funding streams for both capital and operational expenditures (include monitoring and evaluation)
- Risk-mitigation strategies like insurance and contingency funds to ensure projects remain financially stable over time
- Public funding as risk mitigation for private sector investment, particularly during the early stages of NbS adoption
- Economic incentives to encourage stakeholder participation in NbS including subsidies, tax breaks, and payments for ecosystem services
- Simplified application processes and decentralized funding mechanisms to reduce administrative burdens for local actors
- Flexible financing instruments, such as grants, concessional loans, and blended finance, should be available to suit various project scales.

An example of enabling finance in Brazil

Financing for NbS in **Brazil** comes from a mix of public and private sources, following models similar to water funds. The financing arrangements in various programs aim to mobilize resources from multiple sources, where even, in some cases, the in-kind technical capacities of Project Management Unit members also add up to the financing structure. For example, the Water Producer Program initially provided direct financial subsidies through ANA, the National Water and Sanitation Agency. However, with the involvement of multiple institutions contributing within their own budget frameworks, the program's role has evolved into facilitating resource mobilization for project support. Funding sources include:

- State Water and Environmental Funds
- National Environmental Fund
- International banks and organizations (e.g., NGOs, GEF, etc.)
- Sanitation and energy companies, industries, and water users
- Water use charges
- Financial compensation from beneficiaries
- Clean Development Mechanisms

However, gaps remain in ensuring long-term financial sustainability, particularly in securing continuous investment beyond project-based funding cycles. To mobilize investment in sustainable infrastructure, the Ministry of Regional Development developed an open-access tool to classify Environmental, Social, and Governance (ESG) projects by sector (e.g., water and sanitation), sub-sector, and project cycle stage. The tool assesses project quality and sustainability, using clear, measurable, and recognized impact criteria. This enhances transparency, mitigates risks, boosts investor confidence, and helps prevent greenwashing.

INSTITUTIONAL ARRANGEMENTS. NbS present a greater coordination challenge than conventional water security investment because they are typically deployed across large geographical scale and involve a wide range of actors in a range of sectors, e.g., water, urban planning, forestry, and agriculture. We found features of successful enabling institutional arrangements for NbS include:

- **Horizontal** coordination to foster collaboration across ministries and sectors ensure alignment in managing water resources and avoiding duplication
- **Vertical** coordination between national and local governments to ensure programs meet regional and local needs and challenges
- **Transboundary** cooperation for international watersheds
- **Engagement** with non-governmental stakeholders, including academic institutions, NGOs, and the private sector

- **Participatory mechanisms** for local communities, and especially Indigenous groups, considering their traditional practices and wisdom in relation to NbS
- **Regular consultations and access to resources** that empower communities to influence outcomes and ensure that their rights and knowledge are respected

At a strategic and operational level, enabling institutional arrangement for NbS include procedures and systems that drive and support better adaptive planning and management, e.g.:

- **Water management planning procedures** that provide for long-term, adaptive planning at watershed, regional, and sub-catchment levels. These tools require flexibility to integrate grey and NbS interventions and incorporate a wide benefits/disbenefits in options appraisal so that strategies can be optimized at a range of scales, time horizons, climate change and socio-economic scenarios.
- **Monitoring and evaluation systems** that drive adaptive management of NbS programs in response to evolving conditions. These systems must provide robust information on water resource quality and quantity, ecosystem health, and impact of NbS, as well as wider socio-economic data that verifies assumptions around costs and benefits.

An example of enabling institutional arrangements in France

The watershed-level planning approach is a major enabler for the adoption of NbS in **France**. The French territory is divided into seven major hydrographic basins, each organized around a principal river system. Within each basin, a Water Agency—a public institution operating under state supervision—is responsible for coordinating water resource protection and management efforts. They engage into transboundary cooperation where relevant (Rhin and Meuse for instance). These agencies collect fees from water users and allocate funding to projects that aim to protect water quality, preserve aquatic ecosystems, and ensure sustainable water use.

To guide water policy at the watershed level, the (basin committees) serve as consultative bodies that bring together stakeholders from local authorities, user groups, and the state (horizontal coordination). They define the strategic plans for water management based on a permanent and large-scale monitoring system in place across all major watersheds. Overseen by the Water Agencies, this system complies with European union Water Framework Directive requirements and covers both water quantity and quality. It also includes assessments of ecological status and biodiversity, considering water bodies not just as resources, but also as habitats.

Watershed and river contracts play an important role in operationalizing these plans. These are non-binding agreements engaging local stakeholders—such as municipalities, water syndicates, chambers of agriculture, and community organizations—and government agencies. While they do not entail a transfer of formal authority, they promote participatory decision-making and foster shared responsibility for water conservation and management within specific watershed areas or their subdivisions.

COMMON EXECUTION CONDITIONS

Technical Capabilities. This category captures enablers that underpin the ability water and sanitation providers and stakeholders to deliver NbS. Of these enablers, *Technical capabilities* were cited in almost all cases studied as one of the critical barriers across all phases of project development including design, finance, implementation, maintenance, and monitoring. Education and training programs at various levels, from graduate studies to vocational training, are essential to equip professionals with the skills needed to support the planning, design, and delivery of NbS programs. Continued professional development through workshops, seminars, and collaborative learning also ensures that expertise remains cutting-edge. This will often mean investing in existing staff to build their capacity and confidence but also forming strategic partnerships and engaging external expertise.

Effective collaboration was also identified as a key enabler because NbS are naturally multisectoral, requiring stakeholders at various scales and from diverse sectors to work together. The benefits of collaboration between local and national authorities, public and private entities in bridging gaps in technical capacity, mandates, and resources are clear, and strong institutional design can support this. However, fostering a culture of collaboration and trust is key to making such arrangements work, irrespective of any mandate. Maintaining institutional memory is a critical element of this, and mechanisms are necessary to ensure that knowledge and lessons learned are retained when staff holding key relationships and knowledge move on.

Interdisciplinary research and partnerships have been at the forefront of NbS design and application in many cases studies, even when existing policy design conditions are not obviously enabling for NbS. These well-connected and dynamic *innovation ecosystems* of research institutions, universities, governmental bodies, NGOs, and the private sector have helped support NbS deployment by offering funding, technical expertise, and capturing learning at all levels. And, by demonstrating success—building the case for mainstreaming NbS at scale.

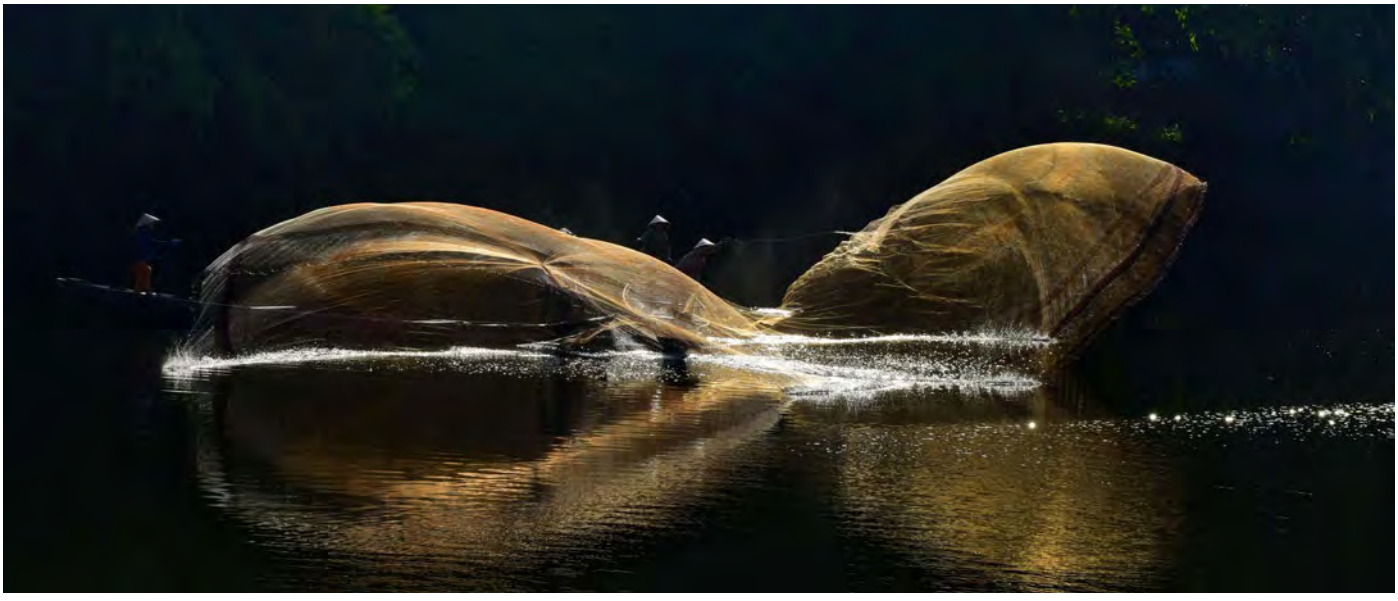
Social capital plays a critical role alongside technical expertise and innovation. Factors, such as cultural, historical, and economic experiences, shape how communities perceive and how open they are to adoption of NbS. This can be critical in countries where private land ownership and other forms of private property rights dominate.

In regions where nature holds cultural or spiritual significance, NbS are more easily accepted. Communities with positive past experiences are more inclined to support these solutions, especially when they lead to tangible benefits such as improved landscapes, livelihoods, and resilience. The creation of jobs, improved local governance, and enhanced social infrastructure are key outcomes that can enhance the popularity of NbS.

Having local structures, such as community-based organizations or cooperatives, can help further enhance the acceptance and scalability of NbS by ensuring that local communities are involved in the planning, implementation, and benefits of these solutions.

The case studies also illustrate the importance of strong leadership for the widespread adoption of NbS, both at high levels of government and at the operational level. Champions, whether individuals or organizations, play a key role in advocating for and driving the adoption of NbS. They build momentum around NbS supporting wider awareness and future application.

Since NbS application requires the cross sectoral collaborative efforts, trust between public and private sector actors, financial institutions, and local communities is vital. Transparent financial mechanisms, which ensure that funds allocated to NbS are used efficiently and offer long-term viability for landowners, delivery bodies and communities, further build this trust. Trust is also reinforced by inclusive planning processes that give all stakeholders a voice and ensure that the needs of local communities are taken into account.



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Brazil

The case study on NbS in Brazil played a pivotal role in the knowledge generation process of this study. The involvement of TNC, particularly through its partnership with the French Development Bank (AFD) provided a strategic entry point for analyzing the general framework and different contexts in three states for NbS implementation by water and sanitation service providers. Brazil's case illustrates how shared "Policy Design Conditions" at the national level can result in very different programs, and that their success is also shaped by "Common Execution Conditions."

While national frameworks—such as the Water Resources Policy Act (PNRH), National Environmental Policy Act (PNMA), National Water Security Plan (PNSH) and Sanitation Plans (National Basic Sanitation Plan - PLANSAB and Municipal Basic Sanitation Plans - PMSBs)—have enabled the integration of NbS across sectors, local programs have adapted these tools in distinct ways. Decentralization, inter-institutional cooperation, and community engagement have been crucial enabling conditions for NbS implementation across Brazil. Success often depends on how common instruments—such as Payments for Environmental Services (PES), basin plans, and tariff design—are adapted to specific ecological, institutional, and governance contexts.

The Water Producer Program, coordinated by ANA at the federal level, promotes watershed restoration through PES, in partnership with several local stakeholders. It aligns with most of the core principles of a water fund: multi-stakeholder governance, blended financing, upstream–downstream cooperation, and long-term sustainability mechanisms. Its focus on compensating rural landowners for conservation practices that benefit water users downstream makes it the closest to a classic water fund model.

In **Minas Gerais State**, *Pro-Springs*, led by the Minas Gerais Sanitation Company (COPASA), integrates NbS funding into water tariffs, enabled by state regulatory approval—demonstrating how utilities can become central actors in habitat protection and restoration. In **Bahia State**, *Guardians of the Water Project*, led by Bahia Water and Sanitation Company (EMBASA) and selected for funding by the National Environment Fund (FNMA) in partnership with the CAIXA Socio-environmental Fund, has successfully combined financial support, institutional cooperation, and community engagement. The active involvement of local communities, particularly through continuous dialogue, technical support, and the hiring of local agents, has been instrumental in shifting perceptions and achieving project goals. In Ceara State, the Water Resources Management Company (COGERH) plays a critical coordination role, primarily through planning, with less utility involvement in source protection. However, Ceará Water and Sewage Company (CAGECE) has explored actions to integrate NbS into its service delivery. As a pilot initiative, the company installed five Constructed Wetland Systems to test sustainable alternatives for wastewater treatment in low-density areas. Additionally, as part of its decarbonization program, a reforestation project will be carried out, prioritizing areas near water reservoirs to enhance water quality.

The study of different experiences in Brazil, both at the federal and state levels, allowed the validation and reclassification of the categories of the framework based on the variability found in the application of the NbS. The Brazilian case was fundamental in testing and developing the analytical framework for application at different scales.

Practitioner insights

The following insights are drawn from interviews and experiences shared with the team during the project. While they do not fit within the structure of analytical framework, they provide valuable context.

NbS ARE A MEANS TO WATER SECURITY

Throughout the engagement process for this study, it was consistently emphasized the primary goal is the protection, restoration, and enhancement of the natural environment, as a means to achieve water security goals—not as an end in themselves Although for some, wider public benefit and environmental objectives were key in NbS being seen as offering better value than conventional grey infrastructure.

The primary focus on water security outcomes is important to acknowledge when engaging with the nature conservation sector because it necessarily limits the scope of NbS investment to those geographies where water security is an issue. This is not to say that the value of ecosystems in other catchments is diminished, but rather it points to being clear about what strategies and funding should be pursued to achieve conservation aims.

NbS ARE UNDERUTILIZED

It is clear—including from the case studies—that interviewees and stakeholders believe NbS have a far greater role to play in addressing water security issues than they currently do. It is also clear that within processes and methodologies there can be an (unintentional) bias toward grey solutions, for example, where cost-benefit analyses and option appraisal processes aren't designed to capture the wider range of benefits of NbS or the full range of disadvantaged of conventional infrastructure. As such, there is not a "level playing field" that provides equal opportunity to all solutions such that of the best value blend of solutions can be adopted.

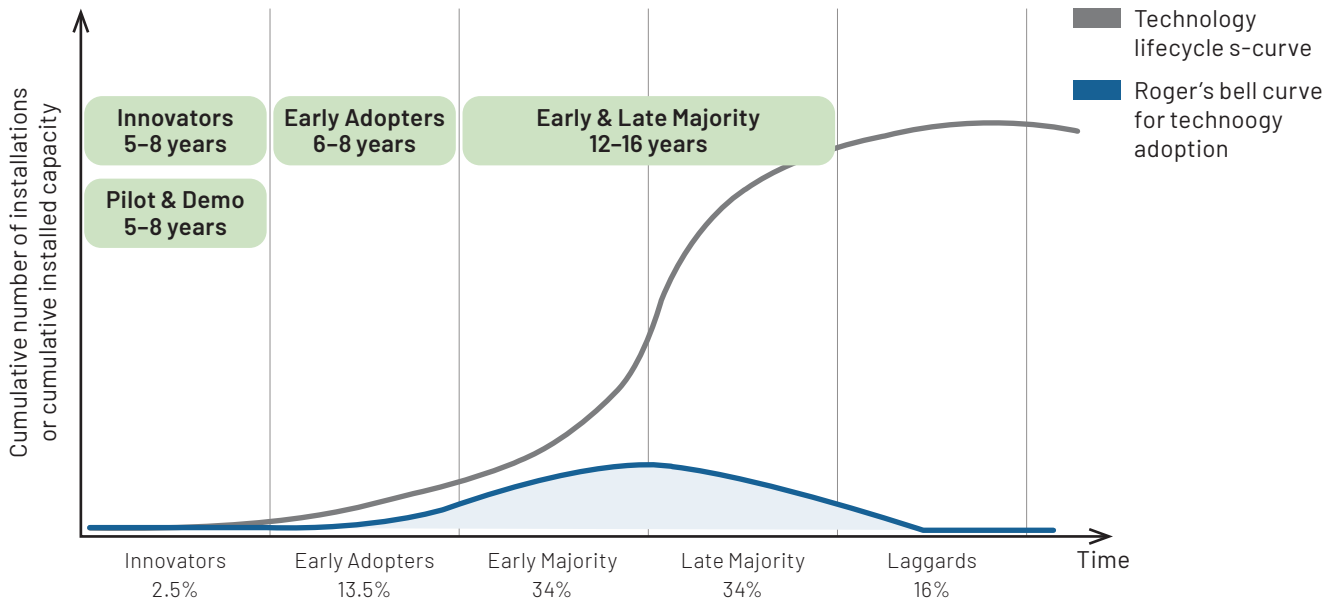
NbS AS AN INNOVATION PROBLEM

Certain forms of NbS can be traced back to long-held cultural practices. Despite this, the application of NbS to address water security is often presented as an innovation in the water sector. In this context, NbS is considered to be in the early stages of the innovation cycle (as shown in Figure 4), with projects struggling to reach scale required to move from early adopters through to mainstream consideration.

The fact that NbS are struggling to cut through should not be a surprise. The water and sanitation sector is widely regarded as slow to innovate with one study finding, on average, new grey infrastructure solutions take 16 years to become mainstreamed.[26]

26 O'Callaghan, P. (2020, December 9). *Dynamics of Water Innovation: Insights into the rate of adoption, diffusion and success of innovative water technologies globally.* https://edepot.wur.nl/536755.

FIGURE 4: Water technology adoption (WATA) model timelines from *Dynamics of water innovation insights into the rate of adoption, diffusion, and success of innovative water technologies globally*, with kind permission of the author.



The question of why the water sector is a slow case has generated significant interest with studies citing a range of barriers, including regulatory complexity, risk aversion, lack of resources, and an insufficient Innovation culture.[27]

While this was not the primary focus of our study, a range of factors highlighted in the literature and interviews present themselves as unique to NbS or exacerbating innovation barriers faced more widely in the water sector. These include:

- Limited *for-profit* opportunities for those promoting NbS, which undermine the normal risk and reward that drives commercial innovation. Factors include:
  - Lack of Intellectual Property Rights for NbS limiting first mover advantage
  - Investment cases that are built on avoided costs don't generate revenue or offer a route to expanding the customer base.
  - Difficulty in excluding those who benefit from watershed investment but do not pay for the ecosystem protection
- Risk allocation and mitigation can be more complex than grey treatment process because:
  - Delivery occurs across multiple land—holdings, with impact often understood at a collective scale.
  - Delivery partners like NGOs and private landowners have limited financial resources, making it legally and reputationally difficult to pursue if delivery does not meet expectations.
  - A lack of design standards and process guarantees limits a buyer's ability to prove liability if interventions/ programs fail.

WINDOWS OF OPPORTUNITY

The case studies also revealed that there can be overarching contextual factors that affect the extent to which NbS can or will be adopted by water and sanitation service providers, but which cannot be incorporated into a framework in a meaningful, consistent, or considered manner. In particular, when faced with a deep crisis, standard or traditional patterns of behaviors can very quickly shift to accept and adopt new and different, solutions, especially when it has become clear that the traditional way of doing things simply isn't anywhere near sufficient to meet new challenges.

27 O'Keeffe, J., Gilmour, D. (2018). *A review of current practice in the provision of water and wastewater services by private developers: Key barriers to the adoption of innovation.* CRW2016_01. https://www.crew.ac.uk/files/publication/CRW2016_01_Review_Wastewater_Service_Private_Developers_Main_Report.pdf.

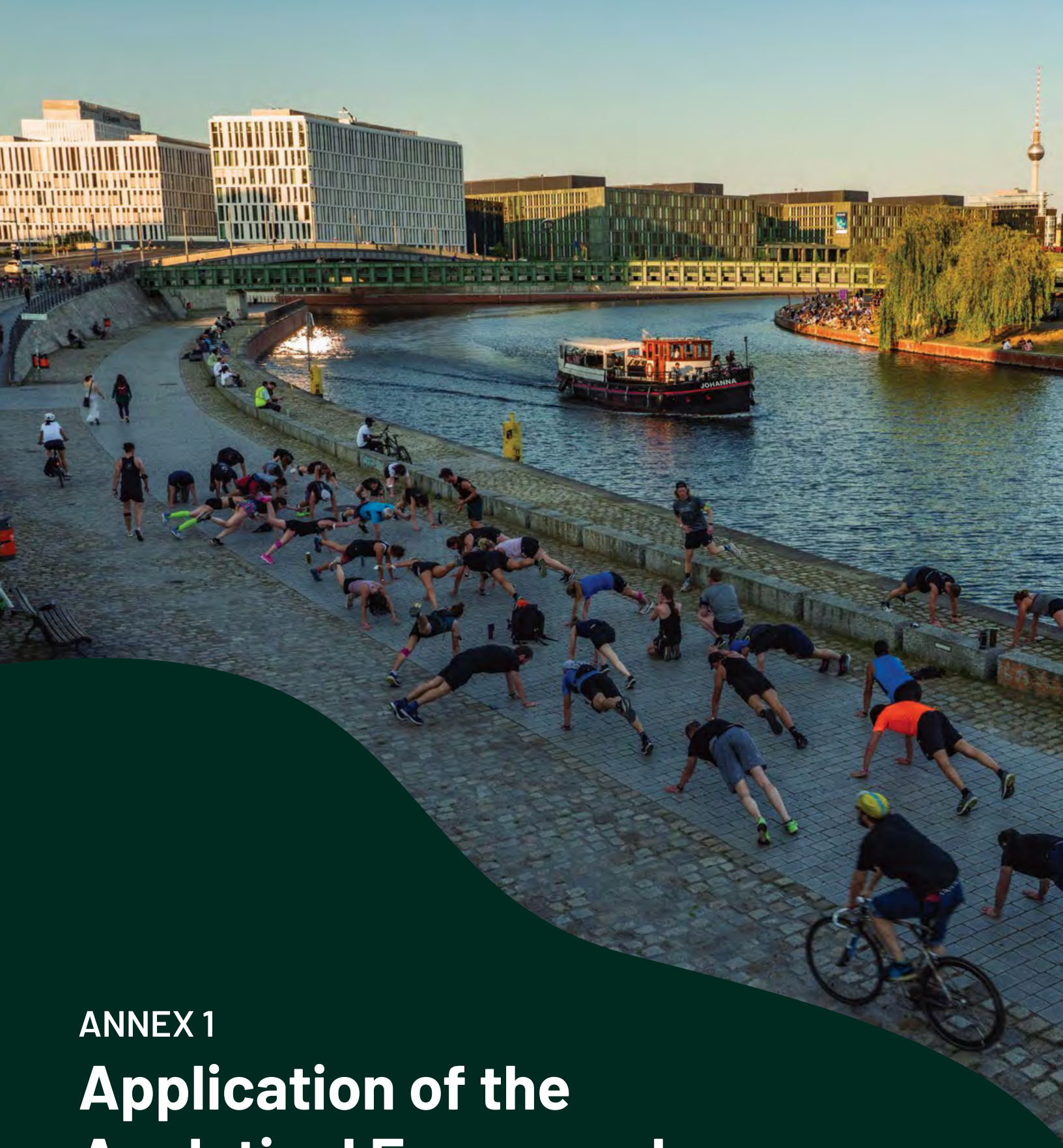
This is exemplified with climate-related shocks, such as extreme droughts or floods, which can trigger a reflection about the existing approaches to water security (Denmark, South Africa). Similarly, political changes can also offer some opportunities to reconsider existing approaches and incorporate new visions. But crises and political shocks may not always drive purely positive change. They can also trigger calls to invest ever greater resources in conventional infrastructure, often alongside a relaxation on environmental protections.

This study will help ensure that when a water crisis occurs, stakeholders, governments, regulators, and water and sanitation service providers can rapidly assess weaknesses and gaps in Policy Conditions that undermine the deployment of NbS and support policy reforms required to enable NbS to play their full role in supporting resilience and water security.

NbS CAN BE—AND ARE—DELIVERED IN AN IMPERFECT SYSTEM

None of the case studies developed during this project reflect the perfect enabling conditions presented in the framework. Indeed, in some cases, enablers were inferred from barriers that NbS developers were facing in their projects rather than evidence of positive policy conditions. But despite this, the case studies capture a rich diversity of NbS being delivered at scale for the benefits of water security and nature.

This highlights a common observation: Unless prohibitions on NbS are absolute, ambiguity and gaps in policy design conditions about how or if NbS can be adopted can often be overcome when *Execution Conditions* are strong. In particular, the case studies suggest the presence of a committed champion is crucial for advancing NbS, while high levels of trust between stakeholders are essential for creating the space to experiment with new and inherently uncertain approaches.



ANNEX 1

Application of the Analytical Framework

Photo: © Jen Guyton

EVALUATING ENABLING CONDITIONS

The framework was primarily designed to be applied at the national and subnational level as a tool supporting multi-stakeholder dialogue for assessing current NbS enablers and barriers, and developing actions to address problems in policy design and execution conditions that support NbS application at scale.

The framework is designed to allow qualitative assessment of how aligned observed conditions are to the optimal for each **enabling condition** with a suggested scale from 1 to 4 (see table below).

1	Poor	The conditions or actions necessary to enable successful implementation of NbS are largely absent or ineffective
2	Fair	Some conditions are in place, but significant improvements are needed
3	Good	Conditions are generally effective in enabling NbS but the ideal conditions are not observed
4	Optimal	Conditions observed align with the ideal ***Enabling Conditions***

This structured approach helps those applying the framework rapidly identify the most important areas that require action and develop strategies for action to unblock barriers or work around them.

Given that NbS requires coordinated multi-sectoral policy efforts, active collaboration across public, private, and civil society sectors, and an ongoing commitment to learning and adaptation, the framework is designed in such a way that it can support an assessment and engagement process that can foster collaboration and build synergies among various stakeholders. By doing so, this approach ensures that NbS can be integrated into broader policy agendas, fostering resilience and sustainability at local, regional, and national levels.

We envisage the framework being applied in an iterative manner, allowing users to gradually build understanding, capacity, and political momentum. This approach is particularly useful in contexts where resources are limited, or stakeholder engagement needs to be progressively developed. For example, a small-scale application at the local or regional level can serve as a first step, generating lessons and insights that inform broader national-scale assessments later on. Alternatively, an initial rapid assessment may be used to identify priority areas or gaps, which can then be explored in more depth through subsequent rounds of analysis.

Stakeholder involvement can also evolve progressively. Early stages may engage a core group of actors—such as public agencies or technical experts—while later phases can expand participation to include civil society, local communities, academia, or the private sector. This gradual engagement helps build ownership, refine the framing of key issues, and ensure that findings are relevant and actionable.

RESOURCE IMPLICATIONS

The framework is designed in a flexible manner and can serve multiple purposes, depending on the objectives of the user and the scale and detail they wish to undertake analysis of each of the components, e.g.:

- **An overview of the enabling factors for NbS application at a local scale**, for example as a previous step before setting up a new investment program, pooled funding, or Fund for NbS. The framework could then help to identify and clarify policy design condition barriers and opportunities, as well as existing execution conditions that might help or hinder the application.
- **An overview at the country/region scale** could be relevant to design a Policy support intervention for the country, by highlighting the elements that need to be addressed, policy updates, regulations and financing mechanisms, among others.
- **A focused application on one or more topics** is also possible. When the actors already know which categories they want to address—for example, Funding and Finance—a more detailed preliminary analysis can be done in this

regard, focusing on key enabling conditions of interest. It is important to highlight that the categories and enablers are typically interconnected, so these links should also be made in any targeted analysis.

- **In-depth analysis of a country or area** would be the most ambitious application, with detailed preliminary analysis and wide stakeholder engagement from different institutions, different administrative levels, civil society, academia, and private sector. This would be relevant to push for a policy design reform toward incorporating NbS for water security into laws, regulations, and policies, and creating the adequate coordination and cooperation mechanisms for execution.

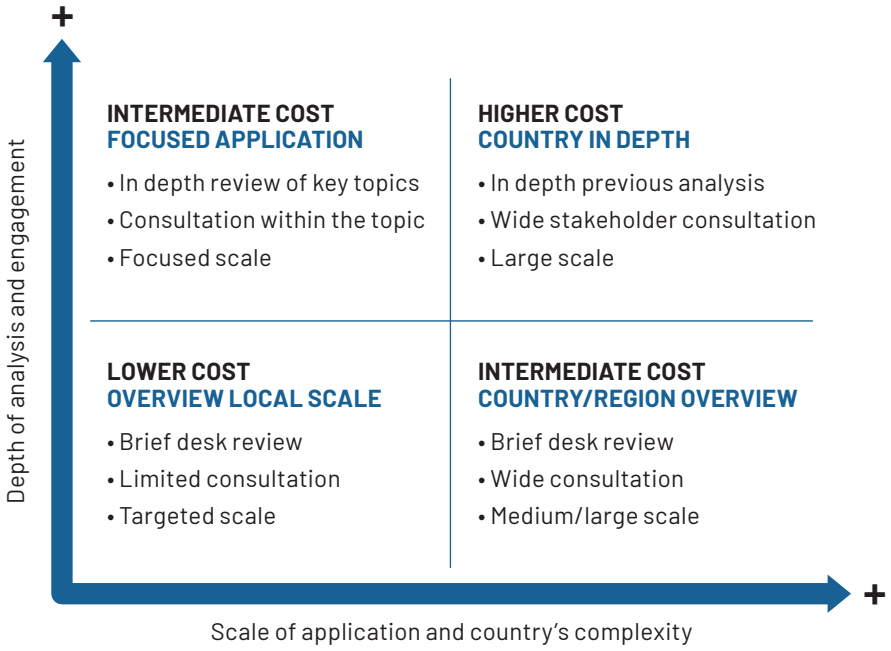
Each type of application will require different capacities and costs of application. The main variables that define the complexity of the application are:

- **The scale of application and the size and administrative setup:** The complexity of the application will vary significantly depending on the level at which it is implemented, whether it's for a specific program, a municipality, a region, a state within a federal country, or an entire country. While some policy design conditions may remain consistent across the country, others can differ based on regional factors. In addition, some countries have a high degree of decentralization, which makes enabling conditions different across the country. For example, regulations may vary between different regions, and financial mechanisms might be tailored to the needs of specific areas. Larger-scale applications require deeper policy analyses and broader stakeholder engagement during the preparation and assessment phase. This necessitates coordinated efforts for consultation and collaboration, including the mapping of likely a considerable number of policies across jurisdictional levels and across sectors, and organizing interviews, meetings, and workshops to ensure effective participation and input from all relevant parties.

- **The detail of the analysis:** The preparation work can vary significantly, depending on the scope and objectives of the exercise. It typically involves an overview of all the main categories of the Policy Design Conditions part, for example, through the collection and analysis of relevant laws, regulations, and policies, as defined above, as well as established financial mechanisms for NbS. However, in some cases, the analysis may delve into a much greater level of detail. This could include a comprehensive comparison of different pieces of laws, regulations, and policies across the country, conducting a quantitative analysis of the financial flows supporting NbS, or proceeding through stakeholder consultations (which may require significant resources for the process of engaging them). This level of detail will increase the cost of the application of the framework. However, they also provide a more robust base for defining and implementing actions for improvement. Desired outputs being defined ahead of time will help practitioners estimate cost and scope of work.

With these variables, it is possible to consider different applications of the framework and the likely implications on cost (Figure 5).

FIGURE 5: Different options for application of the framework, and related estimated costs.



ANNEX 2

Analytical Framework– Enabling Condition Factsheets

Photo: © Rory Doyle

OVERVIEW OF DESIGN

SUMMARY OF ENABLERS

	ENABLERS	CASE STUDY EXAMPLES (SEE ANNEX C)
LAWS		
1.1	**Nature conservation.** Nature conservation is reflected in water-related laws.	China, Netherlands, Ireland
1.2	**Water resource use.** Laws influencing use of water resources is conducive to nature conservation.	South Africa, Ecuador
1.3	**Land use.** Laws concerning land use is conducive to nature conservation.	China, Kenya, Chile
1.4	**Duty of care.** Law requires and enables water service providers to protect water resources.	Ireland, Netherlands, Denmark
1.5	**Legal provisions for investment.** Law provides for funding mechanisms to support water resource protection.	China, South Africa
1.6	**Coherence across laws, regulations, and policies.** There is coherence and coordination across laws, policies, and regulations in relation to NbS. These do not contradict or conflict with each other.	Chile, United States, United Kingdom
REGULATIONS AND POLICIES		
2.1	**International policy alignment.** National policies internalize international policies and commitments that promote the adoption of NbS for water security.	Kenya, Chile, Denmark
2.2	**Promotion and incentivization.** Policies and regulations enable NbS, and where necessary, promote or incentivize their adoption.	Belgium, Ireland, United Kingdom
2.3	**Focus on outcomes.** Policies and regulations are sufficiently outcomes-focused such that no specific solutions are biased or favored.	France, India
2.4	**Cost-benefit analysis.** Cost-benefit analyses create equal opportunity for all solutions, including NbS.	Spain, United Kingdom
2.5	**Treatment of expenditure.** Capital and operational expenditure treatments create equal opportunity for all solutions, including NbS.	Peru, Netherlands, United Kingdom
2.6	**Permitting and compliance.** Regulation sets permitting conditions and compliance requirements that are compatible with the use of NbS.	China, Ireland
2.7	**Procurement mechanisms.** Procurement mechanisms create equal opportunity for all solutions to guarantee water security, including NbS.	Peru, Brazil, India
FUNDING AND FINANCE		
3.1	**Funding through water and sanitation service providers.** These providers have sustainable funding sources to make investments in NbS.	Peru, Ecuador, Belgium
3.2	**Funds transfer mechanisms.** Mechanisms are in place to transfer funding across governmental levels for implementing NbS.	France, Brazil

ENABLERS		CASE STUDY EXAMPLES (SEE ANNEX C)
3.3	**Funding all categories and stages.** Funding sources and investments cover all categories of NbS and all project stages.	Colombia, France
3.4	**Accessible funding.** Funding mechanisms are accessible for potential implementers of NbS.	Belgium, India
3.5	**Economic incentives.** Economic incentives encourage stakeholders to implement NbS.	United Kingdom, United States, Brazil
3.6	**Pooled funding.** Funding mechanisms from different sources can be combined/ pooled for NbS implementation.	Kenya, Brazil
3.7	**Financial overseeing.** Investments into NbS are overseen by the control authorities.	Colombia, France
INSTITUTIONAL ARRANGEMENTS		
4.1	**Intersectoral coordination.** Intersectoral coordination mechanisms within the government are conducive to water security.	Brazil, Colombia
4.2	**Multistakeholder partnerships.** Mechanisms support effective multistakeholder partnerships, including with the private sector.	Peru, South Africa
4.3	**Watershed adaptive planning.** The water systems planning instruments are in place and set out for long-term and adaptive planning.	EU, France
4.4	**Local level participation.** The water policy, planning, and regulatory instruments allow and promote local level engagement and active participation, including the implementation phase.	Ecuador, India
4.5	**Monitoring system.** Intersectoral coordination mechanisms within the government are conducive to water security.	France, United States, Chile
TECHNICAL CAPABILITIES		
5.1.1	**Capacity.** There is sufficient technical capacity across the sector for NbS.	France, Colombia
5.1.2	**Collaboration.** Collaboration and partnerships are common ways of working in relation to water security.	Kenya, Belgium
5.1.3	**Innovation ecosystems.** There is an innovation ecosystem in place that can support the development, piloting, and upscaling of NbS.	Spain, United Kingdom
SOCIAL CAPITAL		
5.2.1	**Cultural.** There are positive norms, attitudes, and values toward protecting and restoring nature and the water environment, and toward NbS.	United States, Ecuador
5.2.2	**Leadership.** Leaders and champions across organizations support and promote the adoption of NbS.	United States, Peru, Belgium, China
5.2.3	**Trust.** There is sufficient trust in and across sectors and stakeholders for collective action toward the adoption of NbS.	United Kingdom, Spain, South Africa

POLICY DESIGN CONDITIONS

1. Laws

The primary legislation passed by the bodies with legislative powers (e.g., parliament),[28] such as the Constitution, or national and subnational Acts/Laws, which can affect directly or indirectly the implementation of NbS. It does not include instruments issued by executive bodies, whether binding or nonbinding, for the implementation of laws (which we consider under regulation).

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28 Adapted from the official UK definitions at https://www.legislation.gov.uk.

1.1 NATURE CONSERVATION

ENABLING CONDITION: Nature conservation is reflected in water-related laws.

A focus on nature conservation creates an integrated approach to protect water resources while addressing broader challenges like biodiversity loss and climate change. When nature conservation is reflected in water-related laws, then policies for NbS can be anchored against it, which can enable water service providers to adopt them when and where they are appropriate.

Features of enabling laws can include:

- That the **rights of nature** are recognized at the highest level—including, for example, through granting legal personhood to nature or rivers.
- Requirements for the **protection** of important freshwater and transitional habitats, especially where they are subject to significant human resource and development pressure. Protection of habitats can be based on the **precautionary principle**.
- Promotion of an integrated watershed management approach for **restoration** of freshwater, transitional, and terrestrial habitats within the wider watershed. Promoted measures may include river restoration, wetland restoration, and reforestation at the landscape scale.
- Requirements for **pollution prevention** through diffuse and point-source control measures at the landscape scale. Promoted measures may include water source protection, spring protection, riparian buffers, constructed wetlands, and agricultural best management practices.

Examples from case studies

Nature conservation is a core aspect of **China**'s Water Law,[29] (revised 2016), reflected in several provisions and principles aimed at sustainable development and ecological protection. General provisions in the law focus on rational development, utilization, conservation, and protection of water resources to ensure sustainable use while meeting ecological needs. Special attention is given to preventing water disasters and maintaining ecological functions. This includes measures to control soil erosion, allocate water for ecological needs, and restore fragile ecosystems. The law also promotes integrated management of hills, rivers, farms, forests, and roads based on small watershed planning to balance development with environmental protection. The "Implementation Plan for Further Strengthening the Protection and Restoration of Water Ecology in Miyun District, Beijing" of 2023 is set under the framework of multiple laws and regulations related to water conservation and environmental protection in Beijing. These include the Water Law (revised 2016), the Law of Prevention and Control of Water Pollution (1996), and Soil Pollution Prevention and Control Law (2018). These laws collectively guide the protection, restoration, and sustainable management of water ecology in Miyun District through stringent water conservation and administration of the water sources of Beijing. The plan includes aspects of spatial planning; ecological protection and green development; water ecological protection and restoration; and ecological space management and control in Miyun Basin.

In 2021, **The Netherlands** had a system review of environmental law. It consisted of a comprehensive and structured assessment of the legislative system's components, processes, and outcomes, with the aim of evaluating its effectiveness, coherence, efficiency, inclusiveness, and alignment with overarching legal, policy, and societal goals—nature protection being a prominent one. Following this process, a large part of the rules for nature conservation were brought together in one new system. The resulting Environment and Planning Act[30] of 2024 has implementing regulations through the Living Environment Quality Decree, the Living Environment Activities Decree, the Living Environment Buildings Decree, the Environmental Decree and the Environmental Regulations, as well as decentralized regulations.

In the **Republic of Ireland**, water-related laws are mainly focused on flood mitigation and drainage to improve agricultural yield. But under the sustainable water resource management principles promoted by the EU, new laws are taking the opportunity to work within a nature conservation framework. The Climate Action and Low Carbon Development Act[31] (2021) goes so far as to establish a definition of what NbS are: *"A solution that is inspired and supported by the process and functioning of nature, which is cost-effective and provides environmental, social and economic benefits and helps to build resilience."*

29 *Water Law of the People's Republic of China (Revision) (Unofficial Translation).* (2009, August 27). http://www.mwr.gov.cn/english/Documents/LawsAndRegulations/202311/P020231102633392643585.pdf.

30 *Ruimte voor de rivieren.* (n.d.). Rijkswaterstaat. https://www.rijkswaterstaat.nl/water/waterbeheer/bescherming-tegen-het-water/maatregelen-om-overstromingen-te-voorkomen/ruimte-voor-de-rivieren.

31 *Climate Action and Low Carbon Development (Amendment) Act 2021.* (2021). Electronic Irish Statute Book. https://www.irishstatutebook.ie.

1.2 WATER RESOURCE USE

ENABLING CONDITION: Laws influencing use of water resources are conducive to nature conservation.

Laws concerning water resource use establish enforceable frameworks for sustainable management and equitable allocation. They can provide a structured pathway to balance water service provision for human needs with nature. Policies for NbS can be anchored against this which, can enable water service providers

Features of enabling laws can include:

- The recognition of the **human rights to water and sanitation** and the **right to a healthy environment** in laws supports a wider approach to sustainability and protection of the resource.
- The state is **mandated by laws** to ensure water for basic human and environmental needs.
- Clear rules and permitting requirements for **water allocation** among economic, social, cultural and environmental needs, including with respect to possible revisions of allocated rights during periods of drought.
- Requirements for **long-term adaptive planning** for water resources, including for environmental needs.

Clear **roles and responsibilities** (institutional design) for the management of water resources at the relevant levels from national to the watershed and local levels (see also coherence enabling condition 1.6).

Examples from case studies

South Africa's approach to water resource management, particularly as embodied in the National Water Act 36 of 1998 (NWA)[32] aims to balance water use with nature protection. This act, along with its associated strategies, integrates various aspects of water management and protection through specific provisions. The NWA moved away from historical water laws tied to land ownership and introduced a system of allocation that prioritizes basic human needs and environmental sustainability. The act guarantees water to meet basic human needs and maintain environmental sustainability as a requirement binding on permitting authorities, known as "the Reserve." The NWA requires the development of a National Water Resource Strategy (NWRS), which provides a framework for managing water resources. The resulting plans include a focus on Alien Invasive Plant management, showcasing how the legislative frameworks enabled the development of relevant NbS solutions as actions to improve water availability and protect native ecosystems.

Ecuador's Constitution[33] guarantees sustainable development that respects biodiversity and ecosystems (Art. 395). It defines water as a strategic, public, and non-privatized resource, prioritized for human consumption and irrigation (Art. 318). The state is responsible for the conservation and integrated management of water resources (Art. 411) and must coordinate this management with an ecosystem-based approach (Art. 412). LORHUYA, a law in Ecuador, highlights nature's right to water conservation (Art. 64) and mandates integrated water resource management with an ecosystem focus (Art. 65).

32 *National Water Act 36 of 1998.* (2014, September 2). South African Government. https://www.gov.za/documents/national-water-act.

33 See official version in Spanish: https://www.gob.ec/sites/default/files/regulations/2018-11/constitucion_de_bolsillo.pdf. Unofficial version in English: https://pdba.georgetown.edu/Constitutions/Ecuador/english08.html.

1.3 LAND USE

ENABLING CONDITION: Laws concerning land use are conducive to nature conservation.

Sustainable land use plays a critical role in enabling water resources management, and yet the relevant land will not generally be in the control of water service providers. Adopting integrated watershed management approaches will require collaborating closely with owners, managers, and occupiers of land to implement NbS (ranging from agricultural land management practices and urban green spaces to informal settlements on floodplains). This can be facilitated by sustainable water management being reflected in land use laws.

Features of enabling laws can include:

- Setting up a **land use framework** that incorporates principles for sustainable water resource management through a focus on sustainable use of water resources for the benefit of all users while recognizing that the protection of the quality of water resources is necessary to meet the interests of all water users. This is achieved through integrated management of all aspects of water resources at the watershed scale.
- **Integrating** spatial planning, land use management, and watershed planning, with specific considerations around NbS.
- Promotion of **natural flood management** measures to reduce flood risk at the watershed scale.
- Promotion of **sustainable land management practices** to reduce soil erosion at the watershed scale.

Examples from case studies

The Water and Soil Conservation Law of the People's Republic of **China**[34] provides a comprehensive framework for preventing and controlling soil and water erosion, protecting resources, and improving the environment. The law mandates the development of water and soil conservation plans, prioritizing prevention, comprehensive control, and measures suited to local conditions. Local governments are required to incorporate water conservation into their economic and social development plans. They must allocate funds for protection efforts and take measures to prevent pollution and degradation of water resources.

The constitution of **Kenya**[35] (2010) provides the basis for natural resource management in the country and recognizes this through the right to a clean and healthy environment, through the management and sustainable development of natural resources, as well as through the economic and social right "to clean and safe water of adequate quantities." The state has the obligation to ensure that water is conserved, that development is managed to be sustainable and to ensure that the benefits accrued are shared equitably. The state holds the forests, specially protected areas and all rivers, lakes, and other water bodies classed as public land in trust for the people of Kenya.

In contrast, the constitution of **Chile** (Article 19, n° 24)[36] guarantees the right to property in all its forms and favors the private appropriation of natural resources. It requires that any expropriation must be made for a public or national interest, be authorized by law, and give rise to previous, fair financial compensation. There is very limited control from the state on the use of private lands. In practical terms, the implementation of any type of NbS in the country requires the full collaboration of the landowners, or alternatively, the purchase of lands.

34 *Water and Soil Conservation Law of the People's Republic of China.* (2010, December 25). https://faolex.fao.org/docs/pdf/chn23747.pdf.

35 Constitution-of-Kenya-2010-min.pdf.

36 *Decreto 100.* (2005, September 17). Ley Chile. https://www.bcn.cl/leychile/navegar?idNorma=242302.

1.4 DUTY OF CARE

ENABLING CONDITION: Laws require and enable water service providers to protect water resources.

The duty of care for water service providers to protect the environment stems from their responsibility to ensure sustainable access to clean and safe water for current and future generations. This is particularly important in the context of climate change, increasing water scarcity, and the need for environmental stewardship.

Features of enabling laws for water service providers can include:

- Recognizing that a legal mandate to protect the environment requires the state to ensure that water service providers develop measures to protect the environment. This requires water service providers to invest in infrastructure, nature conservation, and sustainable practices to safeguard water quality and quantity.
- A provision for water service providers to make **cross-jurisdictional investment** into water source catchments—for example, in long-term maintenance of "green infrastructure."
- The promotion or requirement of **public participation** in water service decision-making processes related to water resource management and environmental protection at the watershed scale.
- Promotion or requirement for water service providers to consider **climate adaptation and resilience planning** to ensure long-term sustainability in water resource management under changing environmental conditions.
- A requirement for water service providers to consider NbS when **protecting drinking water sources at source** and for the **sustainable treatment of wastewater**.

Examples from case studies

In the **Republic of Ireland**, water service providers are legally obligated to protect water resources through a framework of EU Directives and national laws and regulations. Established in 2013, Uisce Éireann has the statutory responsibility for providing public water services and managing water and wastewater investment. The national water utility provides a centralized approach to water services, allowing for long-term improvement and investment in water quality and infrastructure. Local authorities act as agents of Uisce Éireann, performing key public water services functions through Service Level Agreements. Uisce Éireann invests in Integrated Constructed Wetlands to treat wastewater for smaller rural towns to reduce discharge of untreated wastewater into a water body.[37] Constructed wetlands are considered an extension of their asset base that help meet water quality objectives. The Environmental Protection Agency (EPA) focuses on the receiving water body's water quality and is responsible for issuing permits for discharge into a water body.

Article 1.6 of **The Netherlands** Environment and Planning Act[38] of 2021 states that "*every party shall take sufficient care of the physical environment*." This forms part of the general provisions of the law. The law defines the various government entities responsible for water management in The Netherlands. This includes central government, the 12 provinces, 21 water boards, and various municipalities. Provincial government and municipalities are mainly responsible for controlling groundwater levels, with the main water resource management being through central government and regional water boards. The central government is responsible for the national policy and execution of national measures through the executing agency Rijkswaterstaat. Water boards ensure the monitoring, supply and drainage of surface water in their management area, oversee wastewater treatment, and maintain flood defences, such as dikes and dunes.

Denmark is reliant on groundwater for all its water uses and is among the countries in the world most heavily dependent on groundwater. However, the laws, regulation, and policies do not include water utilities as stakeholders of groundwater-protecting measures, and do not provide any facilitation for them to act as NbS implementers. Groundwater management is mainly the task of the 98 municipalities of Denmark, acting under the Water Sector Act (2009) with regulatory measures under the Water Supply Act (1998),[39] Environmental Protection Act (2022),[40] Nature Conservation Act (2022), and Soil Protection Act (1999). The Ministry of Environment and the Environmental Protection Agency (EPA) are responsible for regulating drinking water under the Water Supply Act (1998), including the management of groundwater rights and quality, regulation of wells and boreholes, drinking water quality, and the inspection of local water utilities' operations. Although Danish utilities have invested in NbS pilot projects in the past,[41] it required separate partnership structures and financing.

1.5 LEGAL PROVISION FOR INVESTMENT

ENABLING CONDITION: Laws provide for funding mechanisms to support water resource protection.

Laws foresee funding mechanisms for water service providers to invest in water resource protection as part of their functions.

Features of enabling laws can include:

- Enabling **cost-recovery mechanisms**, such as through taxes, levies, grants, tariffs, or bills, which can be totally or partially directed to water resource protection.
- Requirements for national government to provide water service providers with **infrastructure grants** for water services and drought or flood relief, with an associated duty of care for water resource protection.
- Requirements for national government to provide nature conservation and agricultural support providers with **non-infrastructure grants** for environmental programs, disaster relief, agricultural support, and land management, with an associated duty of care for water resource protection.
- Putting in place a **framework for markets for ecosystem services**, such as carbon credits, biodiversity offsets, payment for ecosystems services, and water quality trading systems.

Examples from case studies

The Environmental Protection Law of the People's Republic of **China**[42]—revised in 2014—establishes a national eco-compensation system aimed at promoting ecological conservation and sustainable development. Article 31 of the law explicitly calls for the establishment and improvement of eco-compensation mechanisms. It stipulates that the state shall increase fiscal transfer payments from the central government to local governments in regions that play a critical role in ecological protection—such as areas rich in biodiversity, water conservation zones, or regions providing important ecosystem services. These transfers flow from higher levels of government (primarily the central government) to provinces, municipalities, or localities responsible for managing and conserving ecologically significant regions. The objective is to compensate these localities for the opportunity costs and management expenses associated with environmental protection, especially in places where development is restricted to preserve ecological functions.[43]

In **South Africa**, financing for water service providers to invest in water resource protection is defined primarily through the National Water Act[44] (Act No. 36 of 1998) under Chapter 5. Key mechanisms include water use charges, polluter pays principal charges, and financial assistance or grants, which may include investments in ecological infrastructure. The South African National Water Resources Infrastructure Agency SOC Limited Act (2024) establishes a state-owned entity to develop and manage national water infrastructure. This agency is empowered to mobilize funding from several sources (government allocation, water use charges—also financial markets and PPPs, but those are at an early stage of implementation) for projects that include water resource protection and sustainable development. Water and sanitation service providers are able to partner with other organizations to access these funds. This represents a shift toward innovative funding models and stronger public sector involvement in critical infrastructure projects.

37 *Climate Action and Low Carbon Development (Amendment) Act 2021*. (2021). Electronic Irish Statute Book. https://www.irishstatutebook.ie/eli/2021/act/32/enacted/en/print.

38 *Environment and Planning Act of The Netherlands*. (2024, January 1). Informatiepunt Leefomgeving. https://iplo.nl/regelgeving/omgevingswet/english-environment-and-planning-act/.

39 *Capital Investment Plan 2020-2024*. (2021.) Uisce Eireann. https://www.water.ie/projects/strategic-plans/capital-investment-plan.

40 *Environment and Planning Act of The Netherlands*. (2024, January 1). Informatiepunt Leefomgeving. https://iplo.nl/regelgeving/omgevingswet/english-environment-and-planning-act/.

41 *Water Supply Act (No. 125 of 2017)*. (2017). UN Environment Programme. https://leap.unep.org/en/countries/dk/national-legislation/water-supply-act-no-125-2017.

42 *Environmental Protection Law of the People's Republic of China*. (2021, November 18). UN Environment Programme. https://leap.unep.org/en/countries/cn/national-legislation/environmental-protection-law-peoples-republic-china.

43 Toward a National Eco-Compensation Regulation in the People's Republic of China. (2016, November). Asian Development Bank. https://www.adb.org/sites/default/files/publication/212726/eco-compensation-regulation-prc.pdf.

44 *National Water Act 36 of 1998*. (2014, September 2). South African Government. https://www.gov.za/documents/national-water-act.

1.6 COHERENCE ACROSS LAWS, REGULATIONS, AND POLICIES

ENABLING CONDITION: There is coherence and coordination across laws, policies, and regulations in relation to NbS. These do not contradict or conflict with each other.

Laws, policies, and regulations in relation to NbS are coherent and aligned within themselves and across sectors, including using **consistent terminology and standardized definitions**. Policy clarity and coherence prevent contradictions, minimize interpretative discrepancies, support cross-agency collaboration, and ultimately facilitate adoption of NbS. Coherence can also include harmonized understanding of NbS functions, performance, and benefits, including the use of **consistent tools and methodologies** across regulatory and implementing agencies.

Coherence among policies affecting water security facilitates horizontal integration across institutional structures, and coordination and collaboration across sectors. This supports the adoption of NbS in a manner that achieves water security outcomes alongside a range of wider environmental, social, and economic outcomes.

Laws establish an overarching framework of **clear roles and responsibilities** for key actors involved in ensuring water security, which is supported by relevant policies and regulations and facilitates coordinated action among concerned institutions, encouraging collaboration and ensuring that all efforts contribute effectively to water security goals.

Features of coherence across policies and regulations can include:

- Consistent use of terminology and definitions in relation to NbS.
- Requirements or recommendations for the application of consistent tools and methodologies for the planning, implementation, and monitoring of NbS.
- Aligned and mutually supportive objectives across intra-sectoral and cross-sectoral legislation, policies, and regulations, especially objectives pertaining to sustainability, environment, natural resources, or adaptation, etc.
- Cross-Sectoral integration mechanisms through formal or informal structures, e.g., integrated planning committees to ensure collaboration between water and other sectors, such as agriculture and urban planning, enabling coordinated action on multi-benefit NbS projects.

Examples from case studies

Chile's Water Code[45,46] treats water as a private economic good, limiting public sector intervention in water resource management. This creates contradictions with climate adaptation policies that promote NbS. While the 2022 Framework Law on Climate Change recognizes NbS, implementation remains inconsistent due to weak coordination mechanisms between environmental and water agencies. Additionally, watershed-level water management is not foreseen in the law, making it difficult to align NbS with broader water security strategies. The Water Code prioritizes allocated water rights for economic uses over ecosystem restoration, creating barriers for NbS adoption in key watersheds.

The Constitution of the **United States** does not explicitly recognize the right to a healthy environment or access to water, sanitation, and hygiene. However, provisions of federal laws promote aspects of this right, including the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA), which address water quality but not the explicit right to safe drinking water and a healthy environment. Similarly, there is no federal law requiring the maintenance of environmental flows, although the CWA includes requirements linked to water quality and aquatic ecosystems protection. Water allocation laws differ significantly across states, creating variability in NbS implementation. States may adopt their own regulations, which must meet or surpass the minimum federal standards for these rights and flows. Some states have enacted "Green Amendments" (e.g., Pennsylvania, Montana, New York), which recognize environmental rights. However, enforcement and implementation vary widely across states, leading to fragmented NbS adoption. The absence of baseline water legislation at the federal level results in regulatory contradictions between conservation programs and existing water rights laws, particularly in states with prior doctrines based on appropriation. In these states, if water users don't use their allocation, there is legal precedence to reduce their water allocation.

In the **United Kingdom**, the Levelling Up and Regeneration Act[47] covers NbS in stating that "*a sewerage undertaker* [wastewater company] *must consider whether NbS, technologies, and facilities relating to sewerage and water could be used to meet the standard.*" However, this law also sets requirements for wastewater treatment works in certain sensitive areas to operate at the Technically Achievable Limit. This automatically drives investment in sewage treatment, as opposed to allowing for catchment offsetting. And, by setting an output standard, which is considered by stakeholders as being unachievable through NbS treatment, the legislation is driving investment in grey infrastructure solutions. See also Enabling condition 2.3.

45 *Water Code* (1981). Ley Chile. https://www.bcn.cl/leychile/navegar?idNorma=5605.

46 *Water Code Reform, Law 21.435.* (2022). Ley Chile. https://www.bcn.cl/leychile/navegar?idNorma=1174443.

47 *Levelling-up and Regeneration Act 2023.* (2023). GOV-UK. https://www.legislation.gov.uk/ukpga/2023/55/pdfs/ukpga_20230055_en.pdf.

2. Policies and Regulations

Policies refer to principles adopted by governments, such as plans, policies, and strategies or technical guidelines, not qualified as regulations, and which may contribute,[48] directly or indirectly, to the use of NbS.

Regulations include the binding rules or directives made and maintained by an Executive branch authority (e.g., Regulator) to enable the effective implementation of primary legislation related to NbS.

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48 Adapted from Government Digital Service UK.(n.d) https://www.gov.uk/.

2.1 INTERNATIONAL POLICY ALIGNMENT

ENABLING CONDITION: National policies internalize international policies and commitments that promote the adoption of NbS for water security.

Global policy frameworks that incorporate calls for NbS are drivers of the adoption of those solutions for water security when translated into national policies, targets, and actions.

Relevant global frameworks include the Sendai Framework for Disaster Risk Reduction (SFDRR), the Ramsar Convention, the Convention to Combat Desertification (UNCCD), the Global Biodiversity Framework of the Convention on Biological Diversity (CBD) (with targets dedicated to ecosystem services and NbS), and the Paris Agreement, with a dedicated "nature" target referring to NbS and ecosystem conservation. The **translation** into relevant national policies can cover areas such as climate adaptation and mitigation, biodiversity, water resource management, and land-use.

National commitments include **clear targets and implementation timelines**, ensuring alignment with international policies and commitments. Transparent **monitoring and accountability mechanisms** are essential to track progress and effectiveness. These mechanisms are also critical for securing **access to international climate and environmental funding sources**.

Features of national policy alignment to international frameworks include:

1. Clear and explicit reflection of international policies and commitments in national policies (specifically as it relates to use of NbS).
2. National climate, energy, biodiversity, and economic policies are integrated and interconnected national policies that align with international frameworks—for example, linking greenhouse gas reduction targets with nature-based solutions and sustainable development goals (SDGs) across sectoral policies.
3. Targeted monitoring and reporting, including on adoption of NbS.

Examples from case studies

Elgeyo Marakwet County in **Kenya** has several laws and policies in place to support NbS for Water Security. These include the Elgeyo Marakwet County Climate Change Act and the Climate Change Fund Act, which contribute to implementing Kenya's obligations under the Paris Agreement. Adopted under these Acts, the Elgeyo Marakwet County Climate Change Action Plan[49] (2023-2027) identifies the rehabilitation, protection, and conservation of water catchment areas as a priority action to strengthen the capacity to manage water resources and wetlands. This initiative is aligned with the National Climate Change Action Plan (NCCAP) III 2023–2027, which aims to enhance water availability through increased and improved water storage, better water governance and management, and enhanced water harvesting.

Chile's Climate Change Framework Law[50] (2022) integrates climate action with sustainable water management and biodiversity protection. It serves as the legal national umbrella directly for its UNFCCC NDC, aiming for carbon neutrality by 2050, while promoting NbS like wetland restoration for carbon sinks.

Denmark's Green Tripartite Agreement[51,52,53] is designed to actively fulfill global environmental and climate commitments hrough measurable, nature-based, and science-driven actions. The Green Tripartite Agreement, while primarily focused on climate mitigation and land use transformation, plays a significant role in strengthening water security through the implementation of Nature based Solutions (NbS). Key actions such as peatland restoration, forest expansion, and the reduction of nitrogen pollution, directly improve water quality and enhance the natural regulation of water cycles. By restoring wetlands and degraded soils, the agreement supports groundwater recharge, reduces surface runoff, and mitigates both drought and flood risks. Moreover, the creation of new national and marine parks protects critical watersheds and coastal ecosystems, reinforcing the resilience of Denmark's water systems in the face of climate change.

49 *The County Climate Change Action Plan (2023-2027) for Elgeyo Marakwet County.* (2023). County Government of Elgeyo Marakwet. https://elgeyomarakwet.go.ke/wp-content/uploads/2024/12/CCCAP-2023-27-EMC.pdf.

50 *Climate Change Framework Law, Number 21.455.* (2022). Ley Chile. https://www.bcn.cl/leychile/navegar?idNorma=1177286.

51 Ministry of Food, Agriculture and Fisheries of Denmark. (n.d.). *The agreement on a green transition of the agricultural sector.* https://en.fvm.dk/news-and-contact/focus-on/the-agreement-on-a-green-transition-of-the-agricultural-sector.

52 Searchinger, T., & Waite, R. (2024, November 12). *Denmark's Groundbreaking Agriculture Climate Policy Sets Strong Example for the World.* World Resources Institute. https://www.wri.org/insights/denmark-agriculture-climate-policy.

53 Mindegaard, A. (2024, November 19). Political Deal reached on Denmark's Green Tripartite – What's in it and what's not? https://www.arc2020.eu/political-deal-reached-on-denmarks-green-tripartite-whats-in-it-and-whats-not/.

2.2 PROMOTION AND INCENTIVIZATION

ENABLING CONDITION: Policies and regulations enable NbS, and where necessary, promote or incentivize their adoption.

Policies and regulations ensure and enable **NbS to be on an equal footing to other solutions**, such that the best mix of solutions can be adopted for a given context and to achieve the relevant outcomes. This can be a combination of green and grey solutions.

To enable equal opportunity for NbS, it will often be necessary to **remove unintentional bias** toward grey solutions and/or set guidance on the treatment of NbS (see other enabling conditions in Policy and Regulation for enabling factors). It may also be appropriate and necessary to **actively promote or incentivize NbS** where/while these have clearly not yet achieved equal status to conventional grey technologies, such as when NbS are still considered innovative, or adoption is largely confined to pilot studies.

There are multiple ways to promote or incentivize NbS through policy or regulation, for example:

Promoting:

- Explicitly requiring) NbS to be evaluated as options for water and sanitation service providers to meet water security objectives (such as in plans submitted to regulators).
- Making guidelines available for the design, implementation, and evaluation of NbS.
- Targeting research and development or innovation programs at the adoption or mainstreaming of NbS.
- Providing or supporting the provision of stakeholder collaboration or learning platforms (such as databases for research or conferences for information sharing);

Incentivizing:

- Allocating targeted funds specifically and solely for the adoption of NbS—for example, specific percent of tariff dedicated to the adoption of NbS.
- Introducing carbon or wider environmental targets, which would necessitate a greater focus on NbS as part of optioneering processes.

Examples from case studies

In **Belgium**, the Blue Deal (2020),[54] a comprehensive policy program to tackle water scarcity, flooding, and drought, explicitly supports the use of NbS, particularly for water retention and improving groundwater levels. The Blue Deal represents a shift toward recognizing NbS as a necessary part of the solution for long-term water resilience. It includes proactive measures to protect water levels, especially during droughts. Additionally, the Blue Deal integrates measures across various sectors—energy, agriculture, transport, and water—to mitigate climate impacts. These policies explicitly promote NbS, such as the restoration of ecosystems, sustainable urban drainage systems (SUDS), and floodplain restoration as climate-resilient water management solutions.

The **Republic of Ireland**'s water resource management has evolved significantly over the years. Before the implementation of the Water Framework Directive in 2000, policies focused primarily on arterial drainage, improving drainage infrastructure, and supporting irrigation to enhance agricultural productivity. With the adoption of the WFD in 2000, there was a significant shift in national-level policy toward more sustainable water management.

In the **United Kingdom**, policies and regulations have been implemented that aim to enable, promote, and incentivize the adoption of NbS. However, despite these developments, many consider the adoption of Catchment and Nature based Solutions (CNbS) has yet to reach its full potential, and that some aspects of policy and regulation still hinder adoption at scale, like enforcement regulations that are difficult to meet or measure in an NbS vs grey infrastructure solution. Ofwat has allowed funding for an innovation program called "Mainstreaming Nature based Solutions" to help address this. It is a £8Mn[55] program that "*brings together multi-sectorial expertise and leadership to collaboratively create and test new solutions [...] and facilitate and enable transition of nature based solutions into business-as-usual to deliver greater value for customers, society, environment*."

54 *Blue Deal*. (n.d.) Dutch Water Authorities. https://dutchwaterauthorities.com/blue-deal/.

55 $10.5 million.

2.3 FOCUS ON OUTCOMES

ENABLING CONDITION: Policies and regulations are sufficiently outcomes-focused, such that no specific solutions are biased or favored.

Overarching policies and regulations focus primarily on **long-term performance objectives that reflect the desired end goals or "outcomes"** (such as healthy water bodies or sustainable abstraction), and that therefore inherently **recognize the relative impacts of other contributing factors and sectors that can** undermine aquatic health (e.g., agriculture, urban runoff, industry). **Outcomes-oriented** policies and regulations **do not solely set output targets** and **do not prescribe specific technical solutions**, enabling innovative solutions to emerge and encouraging collaboration across industries or sectors to achieve shared goals, with long-term success measured by the overall outcome and not just isolated outputs. This helps to enable **adoption of all categories of NbS** and ensure that NbS are not disadvantaged compared to grey solutions such that the best solutions can be adopted for the context, adopting green-grey hybrid approaches when beneficial.

Policies and regulations can tend to focus on water and sanitation providers delivering or performing against "outputs" (such as wastewater discharge limits) rather than outcomes (such as environmental objectives in the receiving water body). Outputs tend to be readily quantifiable, immediately measurable, and therefore, easily regulated, and they can have an important role to play especially in targeting point source pollution. However, they are generally designed rigidly and without considering the relative impact of other sources or factors. This can drive effort and investment that is not proportionally targeted to where the greatest impact comes from, and that can limit cross-sectoral collaboration, especially around land management.

Overarching polices and regulations that are outcomes-focused will:

- Articulate long-term goals that society is looking to achieve.
- Inherently apply to all the relevant contributing sectors.
- Allow for decisions to be made at the most effective level (such as regional or local, often watershed- or catchment-based), incorporating local priorities and using the most locally relevant data and evidence.

Examples from case studies

In **France**, the Environmental Code,[56] and within it the Water law,[57] emphasize ecological and hydrological outcomes rather than prescribing particular infrastructure. The preservation of habitats and wetlands is one of the main obligations formulated in land-use planning legislation. These provisions are integrated into land masterplans further than simply considering protected areas, as they require all existing wetlands to be considered, even when their impact on biodiversity or resource management is not obvious. In addition, the 2010 Grenelle II law[58] mandates environmental flow requirements and protects all water bodies, emphasizing a comprehensive approach to sustainable water management. While NbS are increasingly promoted, the above instruments do not require them over grey approaches. Instead, those frameworks ensure that decisions are based on effectiveness and co-benefits, reinforcing an adaptive and context-specific approach to water security.

Illustrating regulatory barriers, in **India**, the Narmada Valley Development Authority[59] (NVDA) is a government body dedicated to the management of water resources at watershed level (87% of the Narmada River watershed is located in Madhya Pradesh State, the rest in Maharashtra and Gujarat). It was created as a platform to resolve water allocation disputes after a decision from the Narmada Water Disputes Tribunal to allocate a specific amount of water resources to each state. The implementation of this decision was based on a number of projected dams that had to be completed by 2025. As a result, the activities of this watershed authority are centered on the monitoring of this water allocation and the implementation of these infrastructure projects. It does not implement any activity related to water resources conservation.

56 *Code de l'Environnement*. (n.d.). https://www.legifrance.gouv.fr/codes/texte_lc/LEGITEXT000006074220.

57 *LOI n° 92-3 du 3 janvier 1992*. (1992). Légifrance. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000173995. The *Loi sur l'eau et les milieux aquatiques (LEMA) du 30 décembre 2006* also has important provisions on water resources management. https://www.legifrance.gouv.fr/dossierlegislatif/JORFDOLE000017758328/.

58 *LOI n° 2010-788 du 12 juillet 2010*. (2010). Légifrance. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000022470434.

59 National Portal of India. (n.d.). *Website of Narmada Valley Development Authority*. https://www.india.gov.in/website-narmada-valley-development-authority.

2.4 COST-BENEFIT ANALYSIS

ENABLING CONDITION: Cost-benefit analyses create equal opportunity for all solutions, including NbS.

Cost-benefit analysis (CBA) that provides equal opportunity across all solutions, or a "level playing field" for all solutions, will incorporate comprehensive evaluation of **wider social and environmental factors** such that all relevant key benefits (and, conversely, all key negative externalities) can be factored into the decision-making. To the extent feasible, evidenced and consistent **quantified and monetized valuations** are applied to all the benefit categories such that benefits aren't inherently disadvantaged because they are qualitative only. Requirements around **time horizons and performance variability** are carefully considered in the context of appropriate risk and necessary resilience, such that NbS aren't unintentionally excluded because the performance or delivery timeline requirements were designed for single, grey solutions only. **Costs specifically associated with NbS**—such as for stakeholder convening and co-designing—are explicitly recognized and included in a CBA.

Further examples of features in CBA tools and a process that reflect a move toward equal opportunity for all solutions could include:

- CBAs have been repositioned as, e.g., Total Value, Best Value, or System Value analyses, with the inclusion of a wide range of benefits.
- Guidance has been issued on the valuation of a wide range of benefits, including on the weight or relative prioritization of benefits.
- Solution optioneering hierarchies include NbS as default options.
- Application of commonly accepted discount rate that doesn't disproportionally favor short-term benefits.

Examples from case studies

In **Spain**, NbS that were implemented demonstrated their potential for operational efficiency, characterized by reduced operation and maintenance cost. However, the current financing model of wastewater treatment investments involves fixed transfers to municipalities from EPSAR (Public Entity for Wastewater Sanitation) regardless of the technology implemented and without reference to co-benefits. This reduces the incentive to adopt solutions like NbS where the financial viability lies on long-term savings. This highlights the need for a revised funding mechanism that rewards economic and environmental efficiency, encouraging broader adoption of these innovative technologies.

In the **United Kingdom**, the Environment Agency for England has developed and provided a comprehensive suite of quantified and monetized "*environmental outcome metrics*"[60] for water and wastewater companies to use as they develop their water environment improvement plans, with an explicit goal of enabling the greater adoption of NbS.

60 These metrics are not publicly available.

2.5 TREATMENT OF EXPENDITURE

ENABLING CONDITION: Capital and operational expenditure treatments constitute/create equal opportunity for all solutions, including NbS.

Expenditure treatment methodologies that provide equal opportunity across all solutions will look to **avoid or remove "capex bias."** Grey infrastructure projects typically require large upfront capital investments compared to NbS, and one form of capex bias exists when funding or lending institutions prefer or require capital expenditure investments. There can be multiple reasons for this, including that capital expenditure can be simpler and more immediate, can be preferred due to accounting treatment around depreciation, and—for loans or other finance tools—can be considered to provide tangible guarantees ("collateral"). This can be exacerbated, as another or additional form of capex bias, if operating expenditure cannot be capitalized in the same way and the return on investment over time is higher for capital expenditure investment.

In addition, rules around **operating expenditure treatment will also look to avoid or remove bias toward grey solutions**. This includes not disadvantaging potentially longer lead-in times for NbS to reach full operational performance (e.g., forest restoration); not disadvantaging sustained income over time for operating costs (e.g., ongoing maintenance costs for wetlands); not penalizing higher potential operating costs over time irrespective of lower upfront capital costs (most NbS); and allowing a level of flexibility in terms of predictability of costs over time for NbS (e.g., new types of NbS).

Examples of features in expenditure treatment methodologies that reflect a move toward equal opportunity for all solutions could include:

Adopting a *Total Expenditure* "totex" approach (not separating capital and operational expenditures) such that NbS—including (part of) their operating expenditure can be capitalized or treated as capital expenditure such that returns over time can be made against them.

- Allowing for recurring or continued spending over time—rather than one-off or discrete spending—against funds, loans, or grants; and not requiring capital expenditure specifically.

Examples from case studies

Peru has made progress in integrating NbS into water security investments through mechanisms such as the Ecosystem Services Compensation Mechanisms[61] (MERESE, Spanish acronym) created by Law n°30215 of 2014, alongside the updated Modernization of Sanitation Services Law.[62] This framework allows water utilities to invest in ecosystem conservation and watershed restoration as part of their capital and operational expenditure plans. However, despite regulatory support (and especially Decree n°1280 mentioning the obligation for service providers to transfer funds to MERESE), actual investment in NbS remains limited due to administrative and technical barriers. Accessing these funds involves overcoming administrative complexities and demonstrating the viability of NbS. Additionally, the absence of a tariff structure reflecting the real operating costs and economic benefits of NbS limits their integration into regional and municipal budgets. Although NbS are increasingly recognized in national strategies, their financial sustainability still depends on external donors and environmental programs rather than structured, long-term funding commitments.

In **The Netherlands**, a cost/effectiveness analysis and a cost/benefit analysis on the optimal safety strategy for the Room for the River[63] were performed. Cost effectiveness of the reduction of the water level was expressed as mm/million euros or reduction of flooded area as m^2/million euros. This allows for selection of the most cost-effective measure for each river branch or river stretch. The general conclusion was that relocating embankments and bypasses, lowering groins, and lowering floodplains yielded the largest design water level effect per million euros invested. The most expensive measures were the removal of hydraulic obstacles and lowering floodplains.[64] It was also concluded that spending more than 2 billion euro for improvement of flood protection in the Dutch rivers was economically viable.[65] The Room for the River Programme had a total capital expenditure of €2.3 billion, fully funded by the Dutch government. This budget covered the implementation of more than 30 projects. The operational expenditure includes ongoing costs, such as maintenance of completed projects. For instance, floodplains require regular tree cutting to ensure vegetation does not impede river flow, which is necessary to maintain the system's ability to handle high water discharges effectively. These ongoing costs are not included in the initial €2.3 billion budget and represent additional financial commitments for future flood protection and infrastructure maintenance.

In the **United Kingdom**, there is fundamentally no difference in how the regulator of water and sanitation service providers (Ofwat) treats water company expenditure for NbS versus grey infrastructure. However, there are considered to have been implicit, unintended disincentives against NbS within the original approach to costs. Ofwat's move from a Capital expenditure (Capex) and Operational expenditure (Opex) approach to a Total expenditure (Totex) approach, to mitigate against what was perceived to be a "capex bias," created more equal opportunity for NbS. Further adjustments have recently been made specifically for NbS related to the treatment of operating expenditure. Ongoing Opex is considered more difficult to secure than upfront Capex, and Ofwat evolved its approach in their most recent price review with an aim to address this.[66]

61 *MEcanismos de REtribución por Servicios Ecosistémicos – MERESE*. (n.d.). PERÚ–Ministerio del Ambient. https://www.minam.gob.pe/economia-y-financiamiento-ambiental/mecanismos-de-retribucion-por-servicios-ecosistemicos-mrse/.

62 *Peru – Modernization of Water Supply and Sanitation Services Project (English).* (2018, July 5). World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/118971532835034687/peru-modernization-of-water-supply-and-sanitation-services-project.

63 *Ruimte voor de rivieren.* (n.d.). Rijkswaterstaat. https://www.rijkswaterstaat.nl/water/waterbeheer/bescherming-tegen-het-water/maatregelen-om-overstromingen-te-voorkomen/ruimte-voor-de-rivieren.

64 Silva, W., Klijn, F., & Dijkman, J.P.M. (2001, October). *Room for the Rhine Branches in The Netherlands: What the research has taught us*. ResearchGate. https://www.researchgate.net/publication/269406166_Room_for_the_Rhine_Branches_in_The_Netherlands_What_the_research_has_taught_us.

65 Kosteneffectiviteitsanalyse van het maatregelenpakket in de PKB Ruimte voor de Rivier deel 3. https://www.cpb.nl/system/files/cpbmedia/omnidownload/CPB-Backgrounddocument-August2017-Cost-benefit-analysis-for-flood-risk-management-and-water-governance-overview.pdf.

66 *Levelling-up and Regeneration Act 2023.* (2023). GOV-UK. https://www.legislation.gov.uk/ukpga/2023/55/pdfs/ukpga_20230055_en.pdf.

2.6 PERMITTING AND COMPLIANCE

ENABLING CONDITION: Regulation sets permitting conditions and compliance requirements that are compatible with the use of NbS.

Permitting and compliance regimes need to consider the **implications of the early-stage development and adoption of NbS**, and of the more **fundamental and inherent differences between grey solutions and NbS**. Permitting and compliance regimes were often designed for conventional grey infrastructure, or at least at a time when NbS were not considered as part of the suite of solutions adopted. This means they can be unintentionally biased toward or favoring grey infrastructure.

Compliance requirements need to incorporate flexibility in the early stages of adoption of NbS to allow for experimentation, adaptation, and evidence generation, and this flexibility needs to be supported by the legislative, regulatory and policy frameworks that set the compliance regime. When there are reasonable indications of NbS effectiveness and positive impact, including in terms of co-benefits, compliance regimes can enable the body of evidence to be built by **not imposing the exact same, rigid requirements and/or level of confidence intervals on specific outputs** as for grey solutions. This can be done in a way that's **proportional to the risks and issues faced**. Adopting **risk-based adaptive compliance regimes, flexibility for pilot programs and phased compliance requirements** will allow for evidence to be collected, compliance approaches to be evolved and adjusted, and confidence to be built.

Unlike grey infrastructure, NbS roll-out and performance evolves over time and exhibits greater performance variability because they rely on ecosystems influenced by environmental factors such as climate, hydrology, biodiversity, and seasonal changes. This variability requires more adaptive and flexible approaches to performance compliance that **reflect site-specific or time-specific conditions**, can **adjust to changing circumstances** (e.g., trigger-based adjustments if environmental conditions temporarily change) and that **measure performance over time (this too can be done proportional to risks and issues faced). Co-benefits may also be incorporated into compliance assessments** such that they provide the full performance picture.

Examples from case studies

China has gradually integrated NbS into legal and regulatory frameworks, particularly under the concept of "Ecological Civilization." The Water Pollution Prevention and Control Law and the Beijing Water Resources Security Plan (2020-2035) set strict water quality targets, but their implementation remains more favorable to grey infrastructure. The regulatory system set out by the act applies high-performance expectations for pollution control, with compliance frameworks favoring conventional water treatment facilities over NbS due to uncertainties in long-term efficiency. However, policies such as the Three-Year Action Plan for Water Supply Development (2023-2025) encourage the use of NbS, particularly for urban water security. Despite this, NbS still face challenges in meeting rigid pollutant load reduction criteria under China's "Three Red Lines" water governance framework, limiting their full regulatory inclusion.

In the **Republic of Ireland**, the permitting and compliance framework for wastewater infrastructure applies uniformly to both grey infrastructure and NbS. All discharges must meet environmental quality standards, and licensing procedures—whether through wastewater discharge licences for larger populations or certificates of authorization for smaller ones—are based on the performance of the treatment process and its impact on receiving water quality. As the Environmental Protection Agency (EPA) is primarily concerned with meeting environmental standards, it does not prescribe the type of infrastructure used, allowing Integrated Constructed Wetlands (ICWs) to be evaluated on equal terms with traditional wastewater treatment works. This outcome-focused approach demonstrates a degree of regulatory flexibility that is favorable to NbS. However, despite this neutrality, the absence of specific permitting pathways, streamlined approval procedures, and tailored technical guidance for NbS results in variability of implementation across regions. As ICWs move closer to becoming a "business as usual" option, further efforts are needed to clarify approval processes, provide consistent support mechanisms, and ensure that compliance systems actively enable rather than passively tolerate NbS adoption

2.7 PROCUREMENT MECHANISMS

ENABLING CONDITION: Procurement mechanisms[67] create equal opportunity for all water security solutions, including NbS.

Procurement mechanisms provide a **level playing field** for all solutions, including NbS, ensuring fair competition based on performance, sustainability, and cost-effectiveness rather than favoring conventional grey infrastructure. To achieve this, procurement frameworks must remain **technology-neutral**, assessing solutions equitably and avoiding biases toward grey infrastructure. Evaluation criteria consider **environmental, social, and economic benefits**, rather than relying solely on financial costs.

Flexibility in procurement models is key, allowing for **hybrid approaches** that integrate NbS with grey infrastructure. Standardized, science-based metrics are established to fairly assess NbS performance alongside other solutions. Additionally, procurement decisions account for **lifecycle costs and long-term benefits**, such as ecosystem services and resilience.

Capacity building among procurement officials ensures informed, unbiased selection processes, while inclusive procurement criteria allow NbS-specialized organizations—as well as other relevant actors, such as landowners, NGOs, and new entrants to the supply chain—to participate without being excluded by rigid technical requirements. Procurement guidelines and procedures play a crucial role in shaping contracts and agreements, particularly in public spending and international donor arrangements. By **explicitly including NbS**, procurement mechanisms prevent constraints imposed by grey solutions or unrelated agreements. This inclusion can be achieved through **specific provisions for NbS** or by embedding **flexibility** within procurement guidelines.

A well-structured procurement system fosters **innovation, cost efficiency, and sustainability**, ensuring that NbS and other water security solutions are **equitably evaluated and integrated** where appropriate.

Examples from case studies

Institutional mechanisms have been established to facilitate the procurement and financing of NbS in **Peru**. The National System of Public Investment classifies natural infrastructure as an eligible investment with public funds, while the Ecosystem Services Compensation Mechanism[68] (MERESE) allows water utilities to fund ecosystem restoration, ensuring that NbS can be integrated into formal procurement processes. These frameworks have already financed multiple projects, demonstrating institutional pathways for NbS. However, administrative hurdles, technical capacity gaps, and financial constraints still limit large-scale implementation. Specific guidelines apply to public financing for ecosystem-based investment projects in Peru.

In **Brazil**, the rural properties to be part of the Camboriú River Water Producer Project are determined through public calls for proposals. Each call defines the requirements based on the municipal legislation, including the activities eligible for financial support, the procedure for selecting the properties located in the priority areas—preparation of the Technical Project, the Individual Property Project (PIP), the duration of the contract—and the valuation (value per ha/year) of the environmental services eligible for financial support. Activities eligible for financial support include the safeguarding of protected riparian forests and springs, the restoration of degraded areas outside riparian forests and springs, and the protection of areas with native vegetation cover. The PIPs must include mapping and environmental characterization of the sites. The duration of the project is five years, renewable and subject to annual validation.[69]

The Central Public Health and Environmental Engineering Organisation (CPHEEO), which operates under the Ministry of Housing and Urban Affairs of **India**, is widely recognized in the sector and is responsible for publishing a key reference document used to guide the planning and implementation of urban infrastructure projects, particularly in water and sanitation. This manual prescribes the technologies and standards to be used by cities in operationalizing such projects. In addition to this, each state publishes a Schedule of Rates (SoR), which sets the unit costs for executing various types of infrastructure work. As a result, cities and local officials tend to rely heavily on what is included in the CPHEEO manual and the state's SoR. Even when innovative or alternative solutions (NbS or others) are recognized as potentially beneficial, they may not be adopted unless they are explicitly included in these official documents. This highlights a critical area where greater effort is needed—to institutionalize newer technologies and practices by integrating them into the CPHEEO manual and the state-level Schedules of Rates.

67 Here procurement mechanisms refer to the structured and often legally regulated process through which an implementing entity—such as a government agency, NGO, water utility, or other actor—identifies, selects, contracts, and pays external parties (e.g., consulting firms, community-based organizations, construction companies, or ecosystem stewards) to design, implement, monitor, or maintain NbS interventions.

68 *MEcanismos de REtribución por Servicios Ecosistémicos – MERESE*. (n.d.). PERÚ–Ministerio del Ambiente. https://www.minam.gob.pe/economia-y-financiamiento-ambiental/mecanismos-de-retribucion-por-servicios-ecosistemicos-mrse/.

69 *EMASA*.(n.d) Edital de chamamento público No 01/24.

3. Funding and Finance

The ability to raise funds from different funding sources, their predictability and accessibility to the different stakeholders in relation to NbS.

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3.1 FUNDING THROUGH WATER AND SANITATION SERVICE PROVIDERS

ENABLING CONDITION: Water and sanitation service providers have sustainable funding sources to make investments in NbS.

Successful implementation of NbS at **all stages** depends on sustainable funding models that go **beyond short-term grants** and require financial planning that extends **beyond political cycles**. Laws and corresponding regulations play a fundamental role in ensuring sustainable funding.

A fixed revenue stream provides long-term, predictable funding for watershed conservation. For instance, **permanent funding sources**, such as water and sanitation tariffs, create a stable and recurrent revenue stream for investments, especially in the specific areas that contribute to the sustainability of water and sanitation systems.

In some cases, a contribution from **public funding** is essential for ensuring long-term financial and institutional stability, mitigating risks associated with exclusive reliance on private sector funding, which can be challenging due to the long-term operation and maintenance costs and in early-stage adoption of NbS, when private investors have a low-risk appetite.

Examples from case studies

In **Ecuador**, Quito's 2007 Environmental Ordinance[70] legally mandates a revenue allocation, reinforcing the role of policy in securing sustainable funding. A fixed percentage (2%) of Quito Water Company's billing ensures long-term, predictable funding for watershed protection. The fund's unique private trust arrangement and continuous revenue from Quito's water tariff provide stability that contrasts sharply with broader financial and legal frameworks in Ecuador, which often are often project-based and centralize fiduciary oversight under state institutions.

De Watergroep,[71] the main water provider of the Flanders region of **Belgium**, aims to provide reliable water services while investing in infrastructure improvements and sustainability initiatives, and to achieve this has to manage and balance its financial sources. With the agreement of the Water Regulator (VMM), De Watergroep secures part of its revenue coming from water tariffs to NbS. This is budgeted for land purchasing for NbS, or for "Payment for Ecosystem Services" schemes, compensating farmers and landowners for managing land in ways that protect water quality, such as reducing pesticide use or planting cover crops. De Watergroep secures additional funding for this PES scheme EU grants, Flemish government grants, and cost-sharing agreements with provincial governments.

Water and Sanitation Service Providers in **Peru** can finance ecosystem conservation and restoration projects through MERESE, a compensation mechanism that integrates the cost of conservation into water rates. Even though the law states it is voluntary, the National Superintendency of Water and Sanitation (SUNASS) practically requires the EPS to invest in NbS. However, for many EPSs, their funds are insufficient to cover the demands of NbS projects, and most are small-scale.

70 Municipality of Quito. (2007). *Environmental Ordinance: Article II.383.7 – Contribution for the Protection of Water Sources.* Municipal Code for the Metropolitan District of Quito.

71 De Watergroep's website: https://corporate.dewatergroep.be/en/.

3.2 FUNDS TRANSFER MECHANISMS

ENABLING CONDITION: Mechanisms are in place to transfer funding across governmental levels for implementing NbS.

To ensure that funding can be effectively transferred across governmental levels for implementing NbS, **clear financial and institutional transfer mechanisms** must be established. A **legal and regulatory framework** defines the roles and responsibilities of national, regional, and local governments in the allocation and management of funds, ensuring that resources flow efficiently and transparently.

Budgetary alignment and coordination between different levels of government are essential to facilitate fund transfers, avoiding bottlenecks and delays. Mechanisms such as i**ntergovernmental fiscal transfers, earmarked funds, and co-financing agreements** are in place to enable efficient resource distribution. For instance, dedicated NbS funding programs at the national level can allocate resources to local governments through performance-based grants or matching funds.

Governments have the **institutional capacity to manage transferred funds**, with local authorities receiving adequate technical and administrative support to plan and implement NbS projects successfully.

Flexibility in funding mechanisms is crucial, allowing for **adaptive financial flows** based on the specific needs and priorities of different jurisdictions. Additionally, **multi-level governance structures and coordination platforms** should be in place to facilitate communication and collaboration between national, regional, and local governments, ensuring that NbS investments are aligned with broader water security and climate adaptation goals.

Existing national and sub-national funds created by the environment, water resources management, water and sanitation sectors, or others, are operational and NbS implementation mechanisms **do not duplicate** with these official funds but build on them.

Examples from case studies

The financing of water security in **France** follows the "water pays for water" principle, where water-related costs are primarily covered by user fees rather than general taxation. Water agencies[72] play a crucial role in this system, collecting financial contributions from water users through utilities, alongside revenue from abstraction fees and pollution charges. These funds generate approximately 2.2 billion euros annually for water resources protection. They are then transferred to water boards and local authorities through subsidies to projects that enhance water quality, ecosystem restoration, and climate adaptation.

In **Brazil**, at the federal level, River Basin Committees are established to decentralize water management, with the participation of public authorities, water users, and civil society. These committees are responsible for decisions related to the use of water resources. River Basin Agencies act as the executive secretariats of the committees, carrying out technical functions for project implementation and administrative functions for collecting and allocating funds obtained through water use charges, which include water abstraction, effluent discharge, and consumptive uses. The charges are based on the granting of water use rights, with the fees determined by the River Basin Committees and Water Resources Councils, as applicable. For residential users, the charges are collected by water and sanitation service providers, who transfer the funds to the River Basin Committees in the case of state surface water bodies or to the National Water Agency in the case of interstate surface water bodies or groundwater resources. These funds are allocated to investments in watershed restoration and water body pollution control, carried out through the River Basin Agencies.[73] Based on this resource transfer scheme, programs for the protection, conservation, and restoration of water sources have been implemented across the country.

72 The official website of Les Agences de L'Eau: https://www.lesagencesdeleau.fr.

73 *Taxonomias e frameworks ASG para o saneamento e a infraestrutura hídrica: instrumentos para mobilizar investimentos e expandir a infraestrutura sustentável no Brasil.* (2022). Ministério de Desenvolvimento Regional (Brasil). https://www.gov.br/mdr/pt-br/assuntos/seguranca-hidrica/FSBTaxonomiaseFrameworksASGparaSaneamentoeaInfraestruturaHidrica_compressed1.pdf.

3.3 FUNDING ALL CATEGORIES AND STAGES

ENABLING CONDITION: Funding sources and investments cover all categories of NbS and all project stages.

Funding sources and investments are available and comprehensively support all categories of NbS, ensuring funding is not a barrier to delivering the optimum design of NbS or their long-term effectiveness and scalability. Comprehensive **eligibility criteria are in place** to guarantee that **funding mechanisms include all types of NbS**, including **hybrid solutions**. Investments recognize **multiple scales of implementation**, from **local interventions** to **watershed, regional, and national programs**. Financial allocation is **equitable and inclusive**, ensuring that **public, private, and community-led initiatives** have access to resources for all categories of NbS. Investments target diverse ecosystems (urban, rural, coastal, freshwater, and terrestrial).

Additionally, to successfully implement and sustain NbS, funding covers all project stages from feasibility through to delivery and long-term operation. This requires **long-term financial commitments** to secure resources not only for initial implementation but also for ongoing maintenance, monitoring, and adaptation.

Funding mechanisms are **developed to provide dedicated streams for both capital expenditure (CAPEX) and operational expenditure (OPEX)** to ensure the financial sustainability of NbS. Additionally, **stage-specific financing mechanisms** allocate appropriate funds for feasibility studies, design, execution, and scaling.

To address financial uncertainties, **risk-mitigation strategies** such as insurance mechanisms and contingency funds are integrated. **Encouraging long-term investment strategies** is also essential to sustain NbS beyond individual project cycles, preventing funding gaps that could compromise their effectiveness.

Furthermore, integrating **cost-benefit analyses** into financing frameworks highlights the long-term economic, environmental, and social returns of NbS, reinforcing their value compared to grey solutions. Finally, funding models include **monitoring and adaptive funding** provisions, allowing financial adjustments based on performance and evolving needs. A well-structured, long-term financing approach ensures that NbS projects are not only effectively implemented but also remain sustainable and resilient over time.

Examples from case studies

In **Colombia**, Ministerial/Sectorial Resolution 874/2018 defines the type of additional environmental investments (NbS) for the protection of their water supply sources that can be included in the water and sanitation service tariff. These allowable investments include: a) the purchase and isolation of properties; b) aquifer recharge projects; c) restoration; d) protection and recovery of riparian zones and water supply sources; e) water resource monitoring; and f) payments for environmental services related to water regulation.[74] However, service providers are often reluctant to invest public funds in private activities or land due to concerns about corruption and the challenge of ensuring a long-term return on investment. Water service tariff formula in Colombia allows water service providers to include administration, operation, and investment costs associated with the protection of water sources.

The application of the "water pays for water" principle in **France** provides an easy access to funding the activities related to the project, especially restoration works. But there is a gap in financial and human resources in the early stages of the projects. One local authority has to take them in charge and does not always staff with experience in planning long-term, multi-disciplinary projects. Only the local authority's own budget is available to fund the preparation of projects and some part of the coordination component of implementation.

74 *Resolución 874 de 2018*. (2018). MVCT. https://normas.cra.gov.co/gestor/docs/resolucion_minviviendact_0874_2018.htm.

3.4 ACCESSIBLE FUNDING

ENABLING CONDITION: Funding mechanisms are accessible for potential implementers of NbS.

Funding mechanisms for NbS are **accessible**, taking into account the different capacities of a wide range of water and sanitation service providers, as well as other potential implementers like communities, Non-Governmental Organizations (NGOs), and farmers. Mechanisms are in place to access decentralized and local resources to reach implementers operating at the community level who may lack connections to national or international funding streams.

This requires **inclusivity in eligibility criteria**, ensuring that funding programs accommodate both traditional and non-traditional applicants without restrictive requirements. Simplified application and disbursement processes are essential to reduce administrative burdens. Technical support is offered to help implementers with limited capacity navigate funding opportunities. Capacity-building initiatives are available to help implementers acquire financial literacy, empowering them to develop robust proposals and manage resources effectively.

A variety of **flexible financing instruments**—such as grants, concessional loans, and blended finance—is available to suit different project scales and financial capacities.

To ensure sustainability, funding involves **long-term financial commitments** that contribute to strengthening the capacities of implementers over time. This includes monitoring, supervision, and control of the actions carried out with the allocated resources.

Lastly, adopting a **performance-based funding approach**—rewarding measurable environmental and social outcomes—allows smaller actors to secure financing based on impact rather than rigid project classifications. By embedding these principles, funding mechanisms can foster inclusive and resilient water and sanitation solutions that fully leverage the potential of NbS.

Examples from case studies

Belgium offers multiple funding mechanisms for NbS, accessible to water providers and environmental agencies. De Watergroep, the largest drinking water supplier in Flanders, can access government grants, EU funding programs, and public-private partnerships for NbS projects. These include the Flemish Environment Fund, the Blue Deal, and the LIFE Program. However, financing remains fragmented, requiring service providers to secure partnerships with regional authorities and environmental organizations to access funds.

In **India**, funding mechanisms for NbS remain fragmented, with water and sanitation service providers, NGOs, and community organizations facing significant challenges in accessing financing. While national programs such as the Jal Jeevan Mission[75] and Atal Bhujal Yojana[76] provide financial support for water security projects, their focus is primarily on infrastructure development and groundwater management rather than ecosystem-based solutions. These funds are typically linked to broader climate adaptation and conservation initiatives rather than being dedicated specifically to water service providers. Small-scale implementers such as local NGOs and farmer cooperatives struggle with administrative complexities when applying for government grants. Private sector involvement through Corporate Social Responsibility (CSR) contributions has provided some funding for NbS projects, but with limited reliability as a long-term funding source.[77] Additionally, the lack of a streamlined funding framework makes it difficult for NbS projects to be integrated into standard water and sanitation planning at the municipal and state levels. Although some progress has been made in incorporating NbS into urban water management, there is still no dedicated financing mechanism ensuring accessibility to all implementers, and especially to water services providers.

75 *Jal Jeevan Mission.* (n.d.) https://jaljeevanmission.gov.in.

76 Home | Official Website Atal Bhujal Yojana, Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Government of India.

77 *Nature-based Solutions: A review of key issues in India.* (n.d.) UK Government. https://ioraecological.com/wp-content/uploads/2022/09/Nature-based-Solutions.-A-review-of-key-issues-in-India.pdf.

3.5 ECONOMIC INCENTIVES

ENABLING CONDITION: Economic incentives encourage stakeholder to implement NbS.

Economic incentives play a crucial role in encouraging stakeholder participation in the implementation of NbS. To be effective, these incentives must be **diverse and tailored** to different actors and aligned with their economic interests and capacities.

Direct incentives offer immediate financial benefits, such as grants, subsidies, payments for environmental services (PES), tax credits and rebates, low-interest loans, and green bonds. Indirect incentives, meanwhile, help reshape the broader economic landscape to favour sustainable choices. These may include tax deductions and depreciation benefits, reduced cost of capital, market-based instruments (like tradable permits), and regulatory relief. Together, these mechanisms can create an enabling environment that supports the long-term adoption and scaling of NbS.

Accessibility is key, meaning that incentives being **equitably distributed** prevents barriers that favor large institutions while ensuring that small-scale actors—such as local communities, farmers, and NGOs—can also benefit.

For incentives to be impactful, they must be **integrated into existing financial and policy frameworks**, aligning with national and regional regulations to avoid fragmentation and maximize effectiveness. Ensuring **long-term financial viability** is essential, as short-term funding risks disengagement, whereas sustained support fosters continued stakeholder commitment. Incentives are linked to **clear and measurable outcomes**, ensuring that participation contributes to environmental and social benefits, such as improved water quality, ecosystem restoration, and climate resilience.

Stakeholder awareness is another critical factor. Providing **training and outreach programs** helps ensure that beneficiaries understand the incentives, application processes, and long-term benefits. Additionally, **monitoring and adaptive management mechanisms** enable the assessment of the effectiveness of economic incentives, allowing for adjustments based on stakeholder feedback and changing environmental conditions. When designed effectively, economic incentives serve as powerful tools to drive participation, investment, and long-term engagement in NbS implementation.

Examples from case studies

In the **United Kingdom**, high-integrity nature markets are emerging to bring buyers and sellers together, such as for nutrient management or biodiversity requirements. For example, Wessex Water created a Payment for Ecosystem Services scheme to facilitate farmer participation in nitrogen reduction efforts as an alternative to investment in enhanced wastewater treatment (with the environmental and economic regulators supporting this approach). Wessex Water set this up outside of the regulated business as a separate business unit trading as "EnTrade."[78] EnTrade has innovated in nature market design in collaboration with academic institutions, regulators, local authorities, policymakers, and NGOs. It is now established as an independent company as a Market Operator of high-integrity nature markets, which it is aiming to roll out across the United Kingdom.

In the **United States**, a prevalent funding mechanism for NbS is grant programs. An example of a successful grant to support low-tech process-based restoration (LTPBR) was from the Bureau of Land Management (BLM), where $10 million was awarded for six landscapes across the western United States. This funding is supporting the implementation of traditional beaver dam analogs structures, the hiring of a Wyoming Soil Conservation District employee to undertake LTPBR projects in their county, as well as a science team to perform monitoring of the LTPBR projects. Similarly, incentives are used for NbS, such as the USDA's Conservation Reserve Program, which pays landowners to convert environmentally sensitive agricultural land into natural habitats.[79] However, there are challenges for Tribal Nations to meet specifications in many grant programs, which hinders the application process. The San Juan Water Lease Agreement is considered successful as a pioneering example of how collaborative efforts can lead to sustainable water management practices that benefit both the environment and local communities. Co-benefits include community development and education, and the inclusion of community development funding in this NbS project supports NbS education and youth engagement.

To mobilize investment in sustainable infrastructure in **Brazil**, the Ministry of Regional Development (MDR), as part of the Green Investment Strategy for Regional Development, has developed an open-access tool to classify Environmental, Social, and Governance (ESG) projects by sector (e.g., water and sanitation), sub-sector, and stage of the project cycle. The tool promotes sustainable investment by assessing project quality and sustainability levels. NbS are included in the tool's criteria across key areas: pollution prevention and control, water supply improvement, disaster and risk prevention, climate resilience, integration with grey infrastructure, and ecosystem and biodiversity preservation. It aims to foster a culture of responsible project development and public service delivery by enhancing the reputation of companies and investors, improving project performance through certification and impact monitoring, and increasing transparency in asset management and resource use. This contributes to risk mitigation and strengthens investor confidence by requiring clear, measurable, and recognized criteria for impact monitoring, helping to prevent greenwashing.[80]

78 *About Us.* (n.d.). Entrade. https://www.entrade.co.uk/about-us.

79 *Conservation Reserve Program.* (n.d.). U.S. Department of Agriculture, Farms Service Agency. https://www.fsa.usda.gov/resources/programs/conservation-reserve-program.

80 *Taxonomias e frameworks ASG para o saneamento e a infraestrutura hídrica: instrumentos para mobilizar investimentos e expandir a infraestrutura sustentável no Brasil.* (2022). Brazil Ministério de Desenvolvimento Regional. https://www.fsa.usda.gov/resources/programs/conservation-reserve-program.

3.6 POOLED FUNDING

ENABLING CONDITION: Funding mechanisms from different sources can be pooled for NbS implementation.

To guarantee that funding from multiple sources can be effectively combined for NbS implementation, financial mechanisms are **flexible, well-coordinated, and aligned with common objectives**. A clear **legal, regulatory and institutional framework** is necessary to enable the blending of public, private, and international funds without administrative conflicts. **Harmonized funding criteria and reporting requirements** streamline integration, reducing inefficiencies and ensuring transparency.

Since NbS generates **co-benefits across multiple sectors**, funding is structured to reflect contributions from diverse beneficiaries. Identifying these beneficiaries, assessing their willingness or ability to contribute, and establishing appropriate **payment mechanisms** are essential to pooling resources. **Water Funds**, for instance, bring together public and private investors to support watershed conservation. Similarly, **partnerships between National Water Agencies and local institutions** enable co-financing to restore strategic ecosystems.

To ensure the sustainability of pooled funds, **agreements and supervision of investments** are in place to maintain transparency and accountability.

Legal and regulatory mechanisms **facilitate rather than hinder co-funding arrangements** by allowing water funds, multi-stakeholder investments, and market platforms that connect multiple buyers and sellers. On the supply side, NbS providers can attract funding from different sources for the multiple benefits they deliver. **Supportive laws and regulations** also help water and sanitation providers manage delivery risks associated with co-funding, ensuring stable long-term financing.

While co-funding can enhance financial sustainability, **mandating co-funding requirements may create barriers** if levels are difficult to define or enforce. Instead, enabling **voluntary and well-structured co-financing models** can maximize the potential for multi-source investment in NbS.

Examples from case studies

The Eldoret-Iten Water Fund[81] (EIWF) in **Kenya** was established to restore degraded lands in the upstream watershed areas that supply Eldoret's water needs. The initiative is led by TNC in partnership with Eldoret Water and Sanitation Company (ELDOWAS), county governments, and local Water Resource Users Associations (WRUAs). The EIWF employs a blended financing model that combines grants from international donors, contributions from the private sector, and community co-financing. The fund also receives financial support from water tariffs collected by ELDOWAS. However, the absence of a national financing mechanism for NbS remains a barrier to scaling up interventions.

In **Brazil**, the Water Producer Program initially provided direct financial subsidies through the National Water and Basic Sanitation Agency (ANA).[82] However, with the involvement of multiple institutions contributing within their own budget frameworks, the program's role has evolved into facilitating resource mobilization for project support. Funding sources include, among others, federal, state, and municipal budgets; State Water and Environmental Funds; National Environmental Fund; International banks and organizations (e.g., NGOs, GEF, etc.); sanitation and energy companies, industries, and water users; water use charges; financial compensation from beneficiaries; clean development mechanisms. However, gaps remain in ensuring long-term financial sustainability, particularly in securing continuous investment beyond project-based funding cycles.

81 *Kenya: Eldoret-Iten Water Fund.* (2025). Flagship Projects. The Nature Conservancy. https://resilientwatersheds.nature.org/where-we-work/flagship-projects#15.

82 Resolução ANA nº 180, de 18 de Janeiro de 2024. (2025, January 18). Agência Nacional de Águas e Saneamento Básico, Brasil. https://www.gov.br/ana/pt-br/legislacao/resolucoes/resolucoes-regulatorias/2024/180.

3.7 FINANCIAL OVERSIGHT

ENABLING CONDITION: Investments into NbS are overseen by the control authorities.

Investments in NbS must be **effectively overseen by trusted control authorities** to ensure their financial transparency, accountability, and long-term success. Proper oversight helps confirm that NbS projects **deliver intended environmental, social, and economic benefits** while meeting regulatory standards and advancing water security goals.

Financial oversight is essential to **prevent fund misallocation and greenwashing**, ensuring that NbS investments are grounded in sound science and cost-benefit analyses. This reduces financial risks and enhances investor confidence. To prevent mismanagement, **financial accountability and reporting standards** are established, ensuring that funds are used effectively and in alignment with NbS objectives.

To guarantee **long-term sustainability**, authorities promote structured planning, monitoring, and adaptive management, ensuring that NbS projects contribute to **ecosystem resilience and ongoing service provision**. Additionally, aligning investments with **national and international environmental laws, policies and regulations** strengthens credibility and encourages broader adoption of NbS by policymakers and financial institutions.

Beyond compliance, effective oversight fosters **stakeholder trust and public support** by enhancing transparency and demonstrating a commitment to **evidence-based decision-making**. However, excessive screening may lead to delays, increased transaction costs, and reduced investment incentives. Therefore, a **balanced approach** is necessary—ensuring due diligence without imposing unnecessary bureaucratic barriers that could discourage much-needed funding for NbS.

Examples from case studies

Regarding the financing of the *Pró-mananciais* program,[83] the Minas Gerais Sanitation Company (COPASA) in **Brazil**, in accordance with local regulations, may include in the tariff 0.5% of the operating revenue calculated in the previous year for the implementation of the program. Higher expenditures can be made without tariff compensation. The rules for approving investments in the program with resources from the tariff are established by the local regulator (ARSAE) and include, among other things, prioritizing the return of the resources obtained in the region where they originate, guaranteeing transparency and social control, the annual definition of the program's actions (multiannual and annual plan) and physical enabling conditions with annual targets for monitoring in each region of the program, relying on the evaluation of results carried out by an independent company, and external auditing for the control and accounting of the resources related to the program.[84]

In **Colombia**, to be eligible for tariff-based funding, water utilities must make additional environmental investments (IAAs) that meet regulatory requirements. These investments must be aimed at conserving watersheds associated with the water source and must be clearly distinguished from mandatory investments. IAAs can only be fully or partially funded through tariffs if they are not already funded by other agencies, thus avoiding duplication. Strategic intervention areas must be selected in coordination with institutions involved in watershed conservation and aligned with existing watershed planning tools or other environmental investment plans. The Superintendency of Public Utilities (SSPD) is responsible for oversight and requires service providers to submit detailed documentation on administrative, operational, and investment costs. Providers must also report annually through the Unified Information System (SUI), with enabling conditions primarily related to the area of intervention. IAAs must be based on actual expenditure from the previous year. Technical requirements vary according to the size of the provider.

83 Official website of Pró-mananciais: https://promananciais.copasa.com.br/.

84 *Agência Reguladora de Serviços de Abastecimento de Água e de Esgotamento Sanitário de Minas Gerais ARSAE*. (n.d.). https://promananciais.copasa.com.br/wp-content/uploads/2024/03/Resolucao_arsae_154_2021_pro-mananciais_copasa.pdf.

4. Institutional arrangements

The formal structures, roles, and processes established through laws, regulations, or policies defining how stakeholders interact to fulfill key water and sanitation provisions.

4.1 INTERSECTORAL COORDINATION

ENABLING CONDITION: Intersectoral coordination mechanisms within the government are conducive to water security.

The policy framework sets out clearly the coordination mechanisms that need to be in place in relation to water security. First, it outlines the **interinstitutional coordination mechanism**, which focuses on fostering collaboration between different ministries and sectors involved in managing water resources, **across political and hydrological boundaries**. This horizontal coordination ensures that policies, strategies, and actions are aligned across water users, such as agriculture, industry, energy, environment, and water and sanitation services. Effective communication and cooperation between these sectors are vital for the sustainable management of water resources and for addressing the diverse challenges related to water security.

Additionally, the policy framework highlights mechanisms for **vertical coordination mechanisms**, which integrate different levels of government across the national territory. This involves coordination from the national level down to provincial, departmental, and municipal levels. Ensuring that local governments are aligned with national policies and strategies is critical for implementing water security measures on the ground. By fostering this alignment, the policy framework ensures that actions taken at various levels of government are consistent, and that resources are effectively allocated to regions where water security issues are most pressing.

Finally, there are provisions for **transboundary cooperation** mechanisms where relevant. Technical coordination involves the sharing of hydro-meteorological data, managing the operation of infrastructure that affects downstream flow, and collaborating on joint conservation efforts. Joint management bodies, such as River Basin Organizations (RBOs), play a central role in facilitating this collaboration, promoting effective decision-making, and ensuring that both technical and political efforts are aligned toward common water security goals. High-level political coordination at transboundary level is equally crucial, ensuring alignment at the political level to address transboundary water security efforts.

Examples from case studies

The National Environment Council of **Brazil** (CONAMA) was created by Law nº 6.938, in 1981. It is a collegiate and deliberative organ composed of representatives from the three levels of the federation— federal, state and municipal governments—and from the society at large, including the industrial and agricultural sectors, and members that represent civil society through environmental entities of the Republic. Resolutions are reached through voting by all the members.

The National system for water resources in **Brazil** (SINGREH), created by Law n° nº 6.938, de August 31, 1981, is made up of the National Water Resources Council (CNRH), the National Water and Sanitation Agency (ANA), the Water Resources Councils of the States and the Federal District, the River Basin Committees, public bodies that manage water resources, and the Basin Agencies. The National Water Resources Council (CNRH), is a consultative and deliberative collegiate body, created by Law No. 9,433, of January 8, 1997, (amended by Laws No. 9,984/2000. 12,334/2010), and by 2024, it was composed of 50 members with representation from the Federal Government (Ministries), state and district Water Resources Councils, User Sectors, and Civil Organizations. The CONAMA and the CNRH in turn look after the development and coordination of the National Environment Policy with the Water Resources Policy, with its respective plans.

In **Colombia**, the Regional River Basin Committees (CRC) and the Basin Councils are established to facilitate dialog and promote consensus decision-making among the actors involved in the use, management, and conservation of water resources. The CRCs aim to coordinate basin policies and water resource management plans at the regional level, aligning conservation, use, and protection strategies with regional objectives. Involved actors include regional representatives, sectors, and authorities. The Basin Councils play advise on the Watershed Management and Conservation Plans (POMCA), ensuring that the needs of different stakeholders are considered, and support the resulting implementation and monitoring. The Basin Councils are composed of Indigenous and Afro-descendant communities, peasant groups, organizations from productive sectors, water and sanitation service providers, NGOs, Community Action Boards, higher education institutions, and municipalities with jurisdiction in the watershed. Additionally, the Ministry of Environment and Sustainable Development promotes collaborative platforms that encourage collective action from public and private actors focused on the conservation, restoration, and/or rehabilitation of degraded ecosystems, particularly in watershed undergoing comprehensive water resource management. Currently, nine collaborative platforms have been established across the national territory.

4.2 MULTISTAKEHOLDER PARTNERSHIPS

ENABLING CONDITION: Mechanisms support effective multistakeholder partnerships, including with the private sector.

The coordination mechanisms and platforms designed to integrate **non-governmental stakeholders** play a crucial role in enhancing water security management. These mechanisms involve collaboration with a broad range of concerned parties, including academic institutions, **NGOs, the private sector, and citizens**. Academic institutions contribute valuable research, data, and innovative solutions, which can help shape effective water policies and strategies. NGOs often play an essential role in advocating for environmental sustainability, raising awareness, and implementing actions at the grassroots level. The private sector, with its expertise and resources, can offer practical solutions and drive investments in water-related infrastructure.

Furthermore, involving citizens in decision-making processes ensures that local communities, who are directly impacted by water issues, have a voice in shaping policies. These collaboration mechanisms should **be active at various geographical levels**, be it nationally focused, watershed focused, and sub-catchments. The collaboration mechanisms then allow for information exchange, and collaboration **includes the possibility of pooled funding from all partners** for certain actions.

Examples from case studies

The Water Resources Law in **Peru** (Law 29338, 2009)[85] requires the preparation of water resource management plans for watersheds that seek to balance supply and demand among their different users, and to specify responsibilities in the implementation of coordinated actions for water conservation. It also integrates within this process the participation of public institutions, user organizations, service provider companies, and hydraulic system operators. The responsibility for managing and protecting water sources lies with the ANA (National Water Authority); however, the Peruvian State has laid the groundwork for EPS (water and sanitation service providers) to expand their vision toward integrated water resources management at the watershed level (and not only in service provision).

While **South Africa** has a structured system for water resources planning and management down to local level, through the Catchment Management Agencies, evidence show that these have been insufficient to tackle some issues, such as the removal of Alien Invasive Plants (AIP). Under this context, the creation of the Greater Cape Town Water Fund, with the City of Cape Town and private sector as the main investors, provides an innovative funding model allowing blended private and public sector funding, and has become an important investor in NbS for the control of AIP and wider water security in the greater Cape Town region. This mechanism helps to mitigate constraints such as restrictive bureaucratic processes, institutional fragmentation, and inconsistent and insufficient funding. In addition, the Department's Land User Incentive Programme enables private landowners and Non-Government Organizations (NGOs) to apply for funding to control AIPs on their land under certain conditions.

85 *Ley Nº 29338*. (2009, March 31). Congreso de la Republica, Perú. https://leyes.congreso.gob.pe/documentos/leyes/29338.pdf.

4.3 WATERSHED ADAPTIVE PLANNING

ENABLING CONDITION: The water systems planning instruments are in place and set out for long-term and a daptive planning.

Water management planning instruments are designed to enable **watershed-focused planning**, allowing for comprehensive water resource management that takes into account the full watershed socio-ecological system, beyond the political administrative boundaries. These instruments also support **reflective and adaptive planning over the long term**. They are flexible enough to adjust to new information, emerging challenges, and changing environmental conditions, ensuring sustainable water use and protection for future generations.

In addition to watershed-level planning, these instruments also support **planning and action at the sub-catchment level**. This allows for more localized decision-making and targeted interventions that can address specific water-related issues in smaller, more manageable areas within the larger watershed. This approach ensures that both broad strategies and detailed actions are in place to address the diverse water needs across different regions.

To be effective, **the planning instruments at various levels—whether watershed, regional, or sub-catchment—are complementary** and allow for an integrated implementation, fostering synergies and avoiding silo approaches. By connecting efforts at all levels, from broad watershed-wide plans to detailed sub-catchment actions, water management is both efficient and responsive to the dynamic nature of water systems.

Examples from case studies

The **European Water Framework Directive (WFD)**[86] promotes watershed-focused planning by requiring water management based on River Basin Districts (RBDs), which are natural hydrological units that may span multiple administrative boundaries. The WFD establishes RBDs and mandates the creation of management plans for each of them. These plans integrate water quality, quantity, and ecosystem protection at a scale that aligns with natural water flows, ensuring comprehensive management across regions. Additionally, the WFD supports long-term planning with built-in adaptability. Member states are required to set environmental objectives, such as achieving "good status" for water bodies, and to regularly review and update management plans. This adaptive planning process allows for responsiveness to changing environmental conditions and continuous improvement in water management.

The implementation of the WFD in **France** built upon a pre-existing orientation toward watershed-level adaptive planning. The French territory is divided into seven large hydrographic watersheds, each organized around a major river system. Within each watershed, a Water Agency—public institution operating under state supervision—is responsible for coordinating water resource protection and management efforts. They collect fees from water users and allocate funding to projects that protect water quality, preserve aquatic ecosystems, and ensure sustainable water use. They also support the implementation of watershed management plans aligned with WFD objectives. The "*comités de bassin*" are consultative bodies that bring together stakeholders from various sectors—local authorities, users, and the state—to guide water management at the watershed level in France. They define the main orientations of water policy, notably through the adoption of the Schéma Directeur d'Aménagement et de Gestion des Eaux (SDAGE), updated every six years.[87] The SDAGE are informed by a nationwide monitoring of quality and quantity of water resources overseen by the water agencies. The SDAGE are further detailed in the "*Schémas d'aménagement et de gestion des eaux*" (SAGE—water development and management schemes) at a more local level that detail the priority areas for interventions and the objectives. Watershed and river contracts ("*Contrats de bassin*" and "*contrats de rivière*") are collaborative agreements between local stakeholders and government agencies to manage and protect water resources within a specific watershed (watershed contracts) or a specific subdivision of this area (river contracts). While these contracts are not binding, they encourage collaboration and create a shared responsibility for water conservation.

86 *Water Framework Directive.* (n.d.). European Commission. https://environment.ec.europa.eu/topics/water/water-framework-directive_en.

87 One example of SDAGE: *Schéma directeur d'aménagement et de gestion des eaux du bassin Loire-Bretagne.* (n.d.). SDAGE 2022-2027. https://sdage-sage.eau-loire-bretagne.fr/home/le-sdage-2022-2027/les-documents-du-sdage-2022—-2027.html.

4.4 LOCAL LEVEL PARTICIPATION

ENABLING CONDITION: The water policy, planning, and regulatory instruments allow and promote local level engagement and active participation, including the implementation phase.

Local-level engagement in water systems planning and implementation prioritizes active participation and consultation to ensure inclusive decision-making. **Formal participatory mechanisms** are established to involve citizens and local groups in the policy design, regulation, and planning process.

For Indigenous groups, **prior, free, and informed consultation** is guaranteed, ensuring that their rights, knowledge, and needs are respected in the planning and management of water resources. This consultation is carried out before decisions are made, and is regularly reviewed, allowing Indigenous communities to provide input and influence outcomes, and withdraw consent if conditions change.

Furthermore, **the mechanisms enable local groups to actively participate in the implementation** of water management activities, through access to technical and financial resources, when relevant. Finally, the mechanisms include r**egular accountability mechanisms** to inform and discuss progress.

Examples from case studies

In Ecuador, citizen participation is addressed in Article 68 of Organic Law for Water Resources of 2014 (LORHUyA), which establishes that the Sole Water Authority must consult user organizations in a prior, free, informed, and mandatory manner on relevant issues related to water resource management that affect them. Specifically, the same law recognizes collective rights over water, allowing communities, Indigenous peoples, and Afro-Ecuadorian and Montubio groups to participate in the use, management, and conservation of water. These groups have the right to protect water within their territories, participate in its use and usufruct, and manage the water resources in a communal manner to maintain their identity and traditions. They are guaranteed prior, free, and informed consultation on decisions affecting water management and can participate in environmental impact studies. They also have access to reliable water-related information and can exercise social control over activities that impact their ancestral water management practices. The state must coordinate public policies for water conservation within these territories without compromising its authority.

Self-Help Groups (SHGs) in **India** are grassroots collectives, primarily composed of women, who come together voluntarily to pool resources, provide mutual support, and address shared economic and social challenges. While SHGs are administratively informal and typically unregistered, they operate as critical actors in rural development. Their informality allows them flexibility and adaptability, but they gain formal recognition through their registration into financial systems and state-led programs. Through microfinance initiatives, SHGs have access to credit and savings opportunities, enabling economic empowerment at the community level. Additionally, they are central to government programs, which use SHGs as vehicles to implement grassroots initiatives. These groups are considered essential because their deep reach into rural communities and their established networks of trust and cooperation can be instrumental for the implementation of NbS in certain areas.

4.5 MONITORING SYSTEM

ENABLING CONDITION: A monitoring system to evaluate impacts of NbS for water security is in place.

Water sources and their catchment areas are **regularly and effectively** monitored to allow robust assessments of the quantity and quality of water resources, the relationship between water resources, the environment, and ecological health. Monitoring is implemented at a scale and frequency to enable robust evaluation of the impact of NbS on water security. Monitoring programs also include **information on the natural environment** (including land use parameters) to create a baseline for the implementation of watershed-level NbS from which the **benefits can be evaluated** in terms of biodiversity and respect for natural habitats.

The implementation of this monitoring and evaluation system is **part of the mandates of the institutions** responsible for water resources protection and a **specific and sufficient budget** is allocated to it.

Examples from case studies

A permanent and large-scale monitoring of water bodies is in place in **France** and overseen by the water agencies, each one having a major watershed in charge. This monitoring is aligned with the requirements of the EU water framework directive and encompasses water bodies as resources (water quality and quantity), but also as habitat (assessment of bio-physical parameters and biodiversity assessment). The status of water bodies is regularly evaluated and informs the updates of water resources management plans (SDAGE).

The San Juan Water Lease Agreement[88] in the **United States** includes monitoring of how the flow rate changes the river's elevation to backwater areas, with the goal to boost the river's base flow to maintain fish habitat. This monitoring system is embedded into the continuous learning and adaptive management component of the agreement.

In **Chile**, NbS are mentioned as part of the nationally determined contribution for adaptation to climate change,[89] but no monitoring framework was defined in that purpose. The absence of a sufficient monitoring framework for water resources is identified as a weakness, as it does not allow for evaluating the impact of NbS interventions on the quality of raw water, nor to assess the capacity of resilience of the water system or the impact of environmental activities. The Maipo Basin Wetland Conservation Initiative, led by TNC and the Santiago Water Fund, had to develop its own monitoring system from scratch in order to produce evidence of impact and promote accountability for its actions.

88 *San Juan River Water Lease Agreement Partnership for Fish Habitat Improvement.* (n.d.) Colorado River Resilience. https://resilientcoriver.org/wp-content/uploads/2023/12/NM-San-Juan-River-Water-Lease-Agreement-Fact-Sheet.pdf.

89 *Nationally Determined Contribution.* (2022, November). Ministry of the Environment, Chile. https://cambioclimatico.mma.gob.cl/wp-content/uploads/2023/01/Chile-Fortalecimiento-NDC-nov22.pdf.

5. Common execution conditions

The case studies captured a range of issues that fell outside the normative conditions established by the Policy Design Conditions but nonetheless were cited as critical to the success of NbS rollout. A comprehensive survey of these enablers was out of scope of this study but the fact that some common issues were raised repeatedly made them too important to ignore. As a result, they have been captured as Common Execution Conditions in two categories:

- Technical capabilities: The skills and systems that support NbS delivery and innovation.
- Social capital: Having cultural norms that support NbS approaches, leadership to drive change and trust between actors.

5.1 IMPLEMENTATION CONDITIONS

5.1.1 Capacity

ENABLING CONDITION: There is sufficient technical capacity across the sector for NbS.

While **technical expertise in NbS design and maintenance** is essential, so too is the ability to **conduct long-term planning, evaluate benefits, and integrate NbS** into financial and regulatory frameworks. The capacity to assess the costs of ecosystem-based approaches is particularly important, ensuring NbS are valued appropriately within decision-making processes.

The implementers of NbS have access to this capacity internally, through their existing partnerships or through external procurement. The presence of a **thriving private sector or independent organizations** having the appropriate capacity is an opportunity to bridge the capacity gaps that would be identified through the supply of goods or services.

Capacity is *continuously strengthened* through dedicated training opportunities, including graduate studies, vocational training, and continuous capacity building of professionals, ensuring that practitioners across the sector—from policymakers to engineers and contractors—are equipped with the knowledge to plan, implement, and sustain long-term projects. This results in the presence and influence of **communities of practice** in NbS for water security. This process is facilitated by the **stability of staff and leadership** within organizations, allowing institutional memory and expertise to flourish over time.

Service providers in the drinking water and sanitation sector can **capitalize on** their experience in infrastructure planning, budgeting, and stakeholder coordination to align with the specific needs of NbS. This expertise can be complemented by a significant network of contractors, suppliers, and implementers.

A **regulator having capacity and experience on NbS** serves as a central driver of progress, cascading knowledge, standards, and best practices throughout the sector. When this capacity is strong and well-supported, the regulator not only accelerates the adoption and mainstreaming of NbS but also ensures that it does not become a bottleneck, fostering sustainable progress across the sector.

In the essential phase of NbS feasibility studies, the water resources are assessed based on a solid scientific knowledge fed not only by monitoring and data acquisition, but also through modeling. It is essential that this **modeling integrates ecosystems and their interaction with water resources**. Such comprehensive modeling allows the definition of appropriate NbS and also the assessment of environmental co-benefits.

Examples from case studies

France is a country where NbS are well established in the laws, policies, and regulations and implemented on a large scale for the preservation of water resources. They benefit from a significant community of practice, supported by training capacities at the level of technicians and engineers, but also from capacity-building opportunities offered by several public actors, including water agencies, to practitioners. In this context, the French Biodiversity Agency (*Office Français de la Biodiversité*, OFB) has carried out, in the framework of the EU-supported Life-Artisan project, a study on the obstacles and levers to the implementation of NbS on the basis of consultations with the actors implementing or accompanying these projects.[90] It emerges that, among other obstacles identified at the level of the initial phases of an NbS, the difficulty of mobilizing competent resources to carry out reliable financial analyses of these solutions and of ensuring administrative coordination are particularly cited.

In **Colombia**, the absence of capabilities among service providers for implementing additional environmental investments, for the protection of water supply source, has been considered a future obstacle to the application of these voluntary investments. While service providers are already implementing mandatory investments, the application of additional environmental investments requires greater resources and specific expertise for each type of investment in the environmental realm, which they may not initially possess. This lack of knowledge and capacity can lead to resistance to adopting NbS in favor of conventional grey infrastructure solutions. In this context, the experience of Water Funds can support the application of additional environmental investments.

90 *Etude sur les obstacles et leviers à la mise en œuvre des solutions fondées sur la nature pour l'adaptation au changement climatique.* (2022, March). Office Français de la Biodiversité. https://www.ofb.gouv.fr/le-projet-life-integre-artisan/documentation-life-artisan/etude-sur-les-obstacles-et-leviers-la-0.

5.1.2 Collaboration

ENABLING CONDITION: Collaboration and partnerships are common ways of working in relation to water security.

Collaboration among stakeholders is an e**mbedded practice**, seamlessly connecting actors across scales and sectors. **Dialogue** is firmly established between local and national authorities, public and private entities, implementers and policymakers, water sector and others. This approach ensures that partnerships do not merely follow institutional mandates but evolve beyond them, fostering solutions that responsive to emerging challenges. The complementarities between stakeholders naturally help **bridge gaps** in mandates or technical capacities. Rather than being constrained by formal procedures that constrain action within institutional and sectoral silos, collaboration is embraced as an essential part of delivering projects and policies effectively. This coordination is not seen as an additional burden but as an **inherent and natural task** in achieving shared objectives.

Collaboration is also reinforced between programs implemented in **parallel within the same area**, ensuring alignment of efforts, resource optimization, and a more comprehensive impact. This **interconnected approach** prevents duplication, strengthens synergies, and fosters a shared vision for sustainable development. Furthermore, **partnerships extend to civil society**, recognizing the role of community organizations, advocacy groups, and local initiatives in shaping and sustaining collaborative efforts. Their engagement enriches the dialogue, strengthens accountability, and ensures that solutions are inclusive and reflective of diverse perspectives.

The continuity of this cooperation is strengthened by mechanisms that ensure institutional memory, and that the pace of staff's turnover allows **stability and continuation of relationships**. Knowledge is not lost with transitions, but rather deepened and refined. This consistency empowers long-term strategies, enabling projects to extend beyond political cycles or short-term funding streams.

Examples from case studies

In **Kenya**, the Eldoret-Iten Water Fund[91] (EIWF) was established to restore degraded lands in the upstream watershed areas that supply Eldoret's water needs. The approach includes an incentive-based conservation model, where farmers receive free seedlings and technical training in exchange for adopting sustainable land use practices. The coordination mechanism involves both formal and informal structures. Formally, monitoring and evaluation are conducted by the Project Management Unit, which includes roles such as the project manager, operations staff, field conservation coordinator, and monitoring and evaluation personnel. This structure follows specific procedures to implement coordination with farmers, local authorities, and other institutions. Informally, political issues such as budget constraints and resource allocation require a management based on compromise and negotiation to navigate effectively. This blend of formal oversight and adaptive informal management ensures that NbS projects are both accountable and flexible in addressing challenges.

Collaboration among key agencies of **Belgium**—such as VMM (Flanders Environment Agency), ANB (Agency for Nature and Forests), VLM (Flanders Land Agency)—together with local municipalities and governance partners (including provinces and municipalities), enables the coordinated implementation of NbS. By jointly allocating budgets, they are able to align financial resources and activities, leading to greater cumulative benefits. This collaboration facilitates knowledge sharing, leverages diverse expertise, and ensures that NbS projects align with both local and regional goals. In addition, many NbS projects in Flanders are implemented with local community involvement, which increases public support and local stewardship. NGOs like Natuurpunt and community groups play a central and long-term role in engaging citizens, organizing volunteer efforts, and raising awareness of NbS benefits.

91 *Kenya: Eldoret-Iten Water Fund.* (n.d.) Flagship Projects. The Nature Conservancy. https://resilientwatersheds.nature.org/where-we-work/flagship-projects#15.

5.1.3 Innovation ecosystems

ENABLING CONDITION: There is an innovation ecosystem in place that can support the development, piloting, and upscaling of NbS.

Innovation in NbS for water security thrives within a dynamic and well-connected community of practice. This community is embedded within the broader environmental and water resource management sectors, creating synergies between disciplines, institutions, and practitioners. It spans multiple levels of responsibility, ensuring that expertise, insights, and lessons learned are continuously **exchanged and applied** to real-world challenges.

Research institutions and academia play a pivotal role in advancing NbS by generating rigorous evidence, influencing policy, and directly supporting implementation. Their contributions validate the effectiveness of NbS, refine methodologies, and address emerging technical and ecological challenges. By bridging science and practice, they enable **continuous improvement** and ensure that solutions remain relevant and impactful.

A thriving innovation ecosystem is further strengthened by organizations dedicated to fostering new approaches, scaling successful models, and integrating NbS into mainstream water management strategies. These actors provide the **necessary support structures—funding, technical expertise, and policy advocacy**—to empower individuals and institutions to innovate and **take successful pilots to scale.**

Through ongoing research, interdisciplinary partnerships, and the **flexibility** to explore and implement new ideas, the NbS field remains adaptive, resilient, and capable of addressing the evolving challenges of water security and environmental sustainability.

Examples from case studies

Several influential organizations have been instrumental in promoting and supporting NbS in **Spain**. Research institutes such as the Research Institute of Water and Environmental Engineering[92] (IIAMA) at the Polytechnic University of Valencia, the Institute of Environmental Science and Technology[93] of the Autonomous University of Barcelona (ICTA-UAB), and the Group of Environmental Engineering and Microbiology[94] (GEMMA) at the "*Universitat Politècnica de Catalunya*" play key roles in advancing NbS knowledge and capacity. These centers provide cutting-edge research, technical expertise, and pilot projects that demonstrate the potential of NbS. Additionally, institutions like the Biodiversity Foundation and the "*Centro Experimental de Nuevas Tecnologías del Agua*"[95] (CENTA) actively advocate for integrating NbS into water management policies and practices. This highlights the critical role of research institutions in generating knowledge, validating NbS effectiveness, and influencing policy and technical capacity development.

An important insight from the Poole Harbour case study in the **United Kingdom** is that its success was largely driven by the agency of individuals advocating for alternative approaches. These actors identified and engaged like-minded stakeholders within relevant organizations who were willing to support the process. The ability to implement innovative solutions was contingent on an organizational environment that provided sufficient autonomy and flexibility for experimentation. While these actions did not contravene existing regulations, the solutions they developed emerged as exceptions rather than standard practice within conventional decision-making frameworks. Although such innovations represent progress, the broader governance structures and regulatory processes have not yet been adapted to facilitate their routine adoption. Currently, NbS are far from being systematically integrated into policy and planning frameworks. This regulatory approach impedes scalability, as it relies on individual champions rather than an institutionalized culture of innovation.

92 Official website of IIAMA, Research Institute of Water and Environmental Engineering. https://iiama.webs.upv.es/en/home/.

93 Official website of Institute of Environmental Science and Technology (ICTA-UAB)-Universitat Autònoma de Barcelona Research Portal: https://portalrecerca.uab.cat/en/organisations/institut-de-ciència-i-tecnologia-ambientals-icta-uab.

94 Official website of Group Environmental Engineering and Microbiology (GEMMA-UPC). Universitat Politècnica de Catalunya: https://gemma.upc.edu/en.

95 Official website of Fundación Centro de las Nuevas Tecnologías del Agua (CENTA). Hispagua: https://hispagua.cedex.es/instituciones/organismo/55575.

5.2 SOCIAL CONDITIONS

5.2.1 Cultural

ENABLING CONDITION: There are positive norms, attitudes, and values toward protecting and restoring nature and the water environment, and toward NbS.

Perceptions of NbS for water security are shaped by cultural, historical, and practical experiences within communities. Many individuals and societies see NbS through cultural, spiritual, and symbolic lenses, especially when natural elements hold deep significance. NbS and grey infrastructure can be seen very differently in that perspective. The acceptance of NbS is also influenced by prior experiences with environmental projects. Communities familiar with similar approaches may be more receptive, **associating NbS with positive outcomes** such as restored landscapes, improved livelihoods (health, education, food, prosperity), or enhanced resilience.

On an individual level, perceptions vary based on personal experiences, economic interests, and levels of engagement. Some may see NbS as innovative and cost-effective, while others may seek reassurance about their reliability compared to grey infrastructure. These **additional benefits** can serve as powerful leverage points, even when they are not fully supported by proof or are secondary to initial project objectives and foster the upscaling of NbS.

Financial and organizational structures surrounding NbS also shape how they are perceived when communities recognize **tangible benefits**, such as job creation or improved local governance, their support tends to grow. By building on this foundation, NbS can enhance community buy-in of ecosystem-based activities.

Examples from case studies

In the United States, there is a high degree of social acceptance for the San Juan Water Lease Agreement, and it has helped elevate the public's general understanding of Tribal water rights. The co-benefits across reducing endangered fish, education, and community building can be attributed to a social acceptance of the project as it did not have any resulting effects on downstream water users. Incorporating Indigenous knowledge into NbS projects enhances their cultural relevance and acceptance. This is seen with the San Juan Water Lease Agreement, with the Nation's water administrator, stating, "*We have been living adaptively for thousands of years. Let us show you how it is done.*" By embedding these principles into the agreement, the project not only addresses current challenges but also builds resilience and adaptability for future water management efforts.[96]

The Socio Bosque program,[97] implemented for more than 18 years in **Ecuador**, has emphasized voluntary participation, ensuring genuine commitment from participants to conserve their lands. Created as a government and formalized as a program by Ministerial Agreement No. 131 in 2013, one of its strategic objectives is to facilitate and promote the recognition and valuation of environmental services. It included the "Páramo Chapter" to conserve Andean ecosystems and protect water resources. The program also values and respects ancestral resource management practices, integrating them into its conservation strategy.

96 San Juan River Water Lease Agreement Partnership for Fish Habitat Improvement. (n.d.). Colorado River Resilience. https://resilientcoriver.org/wp-content/uploads/2023/12/NM-San-Juan-River-Water-Lease-Agreement-Fact-Sheet.pdf.

97 Official website of Programa Socio Bosque-Ministerio del Ambiente, Agua y Transición Ecológica: https://www.ambiente.gob.ec/programa-socio-bosque/.

5.2.2 Leadership

ENABLING CONDITION: Leaders and champions across organizations support and promote the adoption of NbS.

The **active support for NbS adoption is noticeable at high levels among policymakers**. It is embedded within broader institutional oversight, regulation, and guidance from top-level authorities to local institutions and implementers. This **support is also evident among potential implementers**—those responsible for deciding between grey and green infrastructure solutions. Institutions leading pilot and demonstration projects play a key role in shaping these decisions.

The **presence of champions** is another critical factor. Committed individual(s), when placed in the right conditions and driven by strong determination, can significantly influence the course of events. The presence of one or a few key individuals within organizations can be a decisive factor in the adoption of NbS. This influence may come from their formal mandate and decision-making authority within the organization, but also from their broader ability to shape perspectives through interactions with colleagues, stakeholders, and partners. Their advocacy and leadership can create momentum for NbS adoption, embedding these solutions within institutional practices and policies. **Organizations can also become champions** within a certain sector, promoting and spearheading the adoption of NbS to convince peers, through the development of pilot projects or through efforts toward their upscaling and mainstreaming.

Examples from case studies

The success of the San Juan Water Lease Agreement[98] in the **United States** can be attributed to a few key leaders who championed the initiative, helping elevate the public's understanding of Tribal water rights and the co-benefits of NbS across endangered species protection, education, and community development.

The implementation of NbS in **Peru** has largely depended on the leadership of specific institutions and individuals who have promoted their adoption. The Ministry of Environment (MINAM) and The National Superintendency of Water and Sanitation (SUNASS) have played a key role in advocating for NbS, ensuring that these solutions are recognized in national water security strategies. However, local champions, particularly from NGOs and academic institutions, have been instrumental in demonstrating the feasibility of NbS in various regions, often acting as the bridge between policy and practice.

Similarly, in **Belgium**: NbS projects have benefited from strong leadership at the provincial and municipal levels, where key individuals drive collaboration across agencies. Champions within water utilities (De Watergroep) and NGOs (Natuurpunt[99]) have also played a role in influencing regulatory frameworks.

The River Chief system in **China** is an approach introduced to improve water management and pollution control.[100] Government officials at different levels are appointed as "river chiefs," responsible for protecting, monitoring, and restoring specific water bodies. This system promotes cross-sector coordination, holds officials accountable for water quality, and encourages public participation. First piloted in Jiangsu in 2007 and implemented nationwide in 2016, it has led to improved enforcement and ecological restoration. However, challenges remain, including inconsistent implementation and weak legal enforcement. Despite this, the system has contributed significantly to China's water pollution reduction efforts by embedding the designation of individuals as positive leaders of the process.

98 San Juan River Water Lease Agreement Partnership for Fish Habitat Improvement. (n.d.). Colorado River Resilience. https://resilientcoriver.org/wp-content/uploads/2023/12/NM-San-Juan-River-Water-Lease-Agreement-Fact-Sheet.pdf.

99 Official website of Natuurpunt: https://www.natuurpunt.be.

100 Wang, B., Wan, J., & Zhu, Y. (2021, October 4). River chief system: An institutional analysis to address watershed governance in China. *Water Policy*, Official Journal of the Water World Council. https://iwaponline.com/wp/article/23/6/1435/84468/River-chief-system-an-institutional-analysis-to.

5.2.3 Trust

ENABLING CONDITION: There is sufficient trust in and across sectors and stakeholders for collective action toward the adoption of NbS.

Trust among partners is strong, built on the **understanding that collective action offers mutual benefits.** Collaboration is seen not as a risk but as an opportunity to amplify impact, reduce duplication, achieve greater resilience in water security, and deliver wider benefits equitably.

Financial mechanisms operate with full confidence from contributors and beneficiaries alike. Funds allocated for NbS are managed transparently, ensuring that resources are not lost, misused, or redirected, and that financial flows support long-term sustainability. The certainty that investments will be used effectively encourages greater participation from public, private, and philanthropic sources.

Sector leaders, policymakers, and regulatory bodies earn trust by **demonstrating a commitment to the common good**. Water service providers, in particular, build credibility through their established expertise in delivering reliable services. Even when their role as NbS implementers is different, their track record in water management provides a solid foundation for confidence.

Trust is reinforced by past successes. Each collaborative effort that delivers tangible results strengthens confidence in future partnerships. It is further transparent monitoring, where the progress and costs of NbS are measured against a clear baseline, ensuring accountability. Inclusive planning processes, engaging diverse stakeholders, ensure that trust is not only maintained but continually deepened, driving long-term commitment to water security solutions.

Examples from case studies

In the **United Kingdom**, several factors have led to a significant and rapid decline in trust in the water sector, which needs to be rebuilt. This has led to policies and behaviors that can be unhelpful for the adoption of NbS. Public pressure and media blame has also created reputational risk for third parties working with water companies—undermining the willingness or ability to be able to collaborate effectively together, which is vital in deploying NbS. Pressure on government and regulators to be tough on utilities heightens the sense of risk of failure and caution around the use of NbS.

One of the main obstacles limiting NbS implementation capacity in **Spain** is technical mistrust, rooted in historical issues. During the 1980s, several early NbS implementations suffered from poor designs, inadequate sizing, and significant maintenance shortcomings, leading to mediocre or failed performances. These negative experiences, widely publicized at the time, had a disproportionate media impact, overshadowing successful cases and common failures in conventional grey technologies. This has created a persistent perception that NbS are less viable or reliable.

In **South Africa**, the Working for Water program has provided an operational model for Alien Invasive Plant (AIP) clearing,[101] but ensuring consistent follow-up maintenance remains a critical challenge. Without regular re-clearing, invasive species quickly re-establish, negating initial water savings. Monitoring frameworks and digital decision support tools are helping to enhance project accountability and efficiency and build trust with various stakeholders.

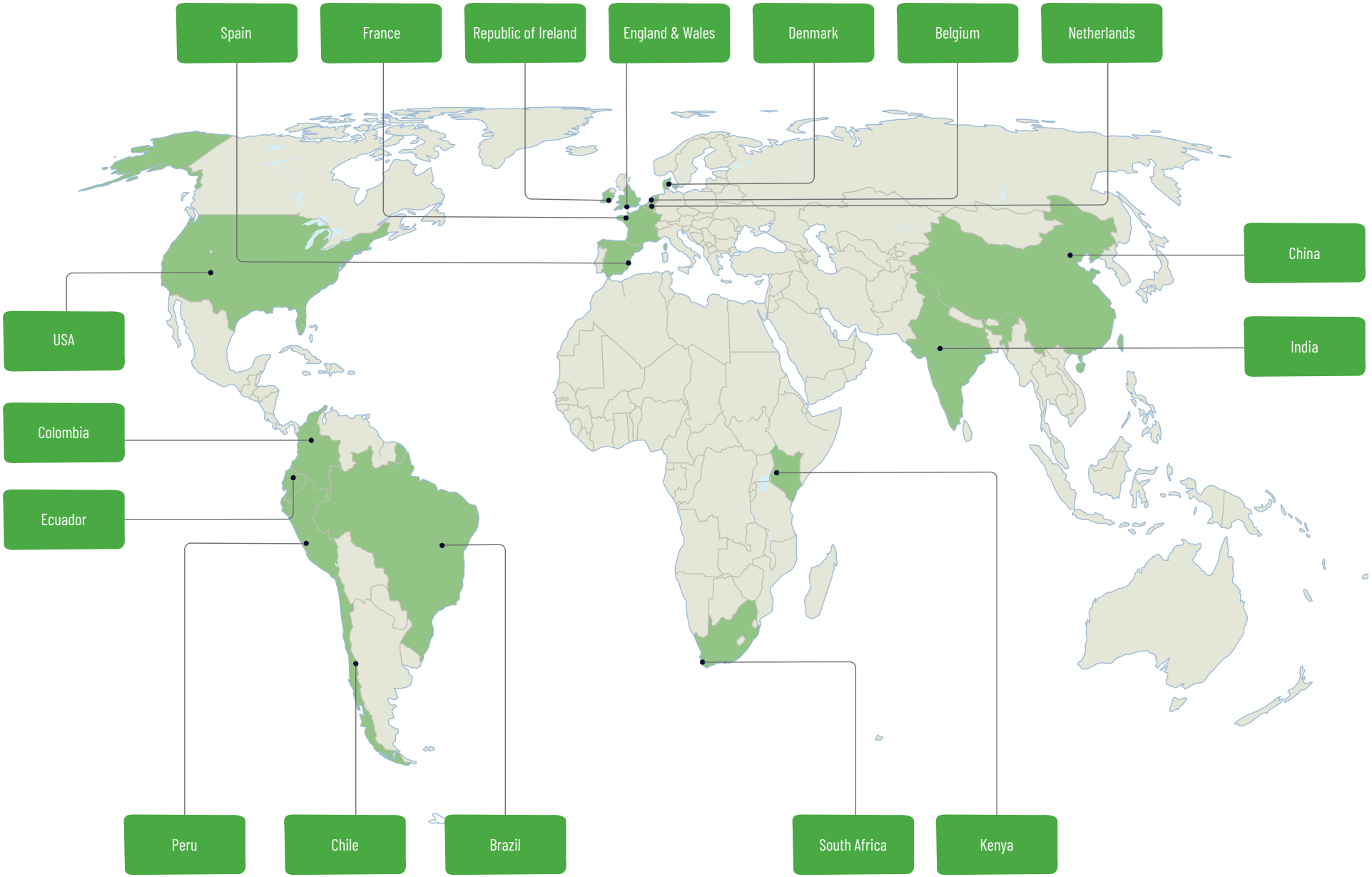
101 Van Wilgen, B. W., & Wannenburgh, A. (2016). Co-facilitating invasive species control, water conservation and poverty relief: Achievements and challenges in South Africa's Working for Water Programme. Current Opinion in Environmental Sustainability, 19, 7–17. https://apirs.plants.ifas.ufl.edu/site/assets/files/367510/367510.pdf.

THE POWER OF POLICY:
CREATING THE CONDITIONS TO SCALE
NATURE-BASED SOLUTIONS FOR WATER SECURITY

Case Studies

Photo: © Susan Hanson/TNC Photo Contest 2022

Case Study Locations



	NbS Primary Objective				NbS Deployment	
Country	**Drinking Water Quality**	**Drinking Water Quantity**	**Wastewater Quality**	**Surface Water Management**	**Watershed**	**End-of-Pipe**
Belgium		✓			✓	
Brazil			✓			✓
Chile	✓	✓			✓	
China	✓	✓			✓	
Colombia	✓	✓			✓	
Denmark	✓			✓	✓	
Ecuador		✓			✓	
England & Wales			✓		✓	
France		✓			✓	
India		✓			✓	
Kenya	✓	✓			✓	
Netherlands				✓	✓	
Peru		✓			✓	
Republic of Ireland			✓			✓
South Africa		✓			✓	
Spain	✓	✓	✓			✓
United States		✓			✓	

Belgium

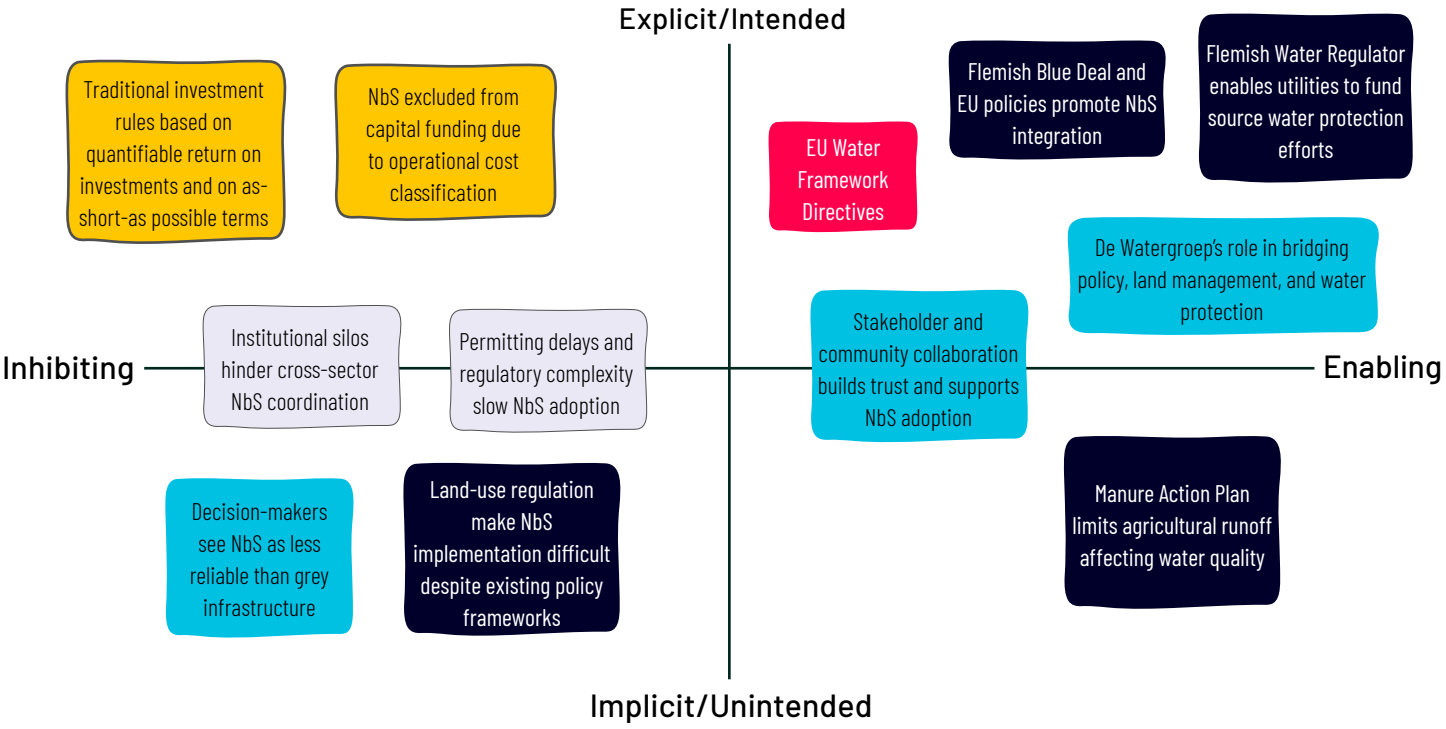
De Watergroep, largest drinking water supplier in Flanders, tackling pollution threats through NbS

Strengthening water quality protection by collaborating with farmers and conservation groups to implement NbS around abstraction areas.

Context

Water Security: Flanders is one of the most water-stressed regions in Europe, facing mounting challenges due to urbanization, agricultural runoff, industrial pollution, and climate change-induced droughts. Approximately 50% of the region's drinking water is extracted from groundwater, which is increasingly contaminated by pesticides, nitrates, and industrial discharges. Seasonal variability exacerbates the issue, with droughts reducing river flows by 20% to 30% and leading to elevated concentrations of nutrients and contaminants. In 2019, nitrate concentrations exceeded 50 mg/l in several rivers, exceeding EU drinking water standards[1], while in 2020, 24% of surface water monitoring points recorded pesticide levels above regulatory limits.

Water Resources Management: The governance of water resources in Belgium is highly decentralized, with responsibility for water quality split between regional authorities and water utilities. De Watergroep operates 85 groundwater and five surface water abstraction sites across Flanders, supplying drinking water to nearly half of the Flemish region's population. While catchment protection falls under the jurisdiction of the Flemish government, utilities like De Watergroep play a growing role in ensuring long-term water security by promoting collaborative land-use strategies with farmers and conservation organizations.



1 This standard from the EUFD has been transposed into Belgian national law under Royal Decree of January 14, 2002, defining the water quality for human consumption.

Factsheet Summary	
Main facilitator	De Watergroep Vlaamse Milieu Maatschappij (VMM) – Flemish Environment Agency Agency for Nature and Forest Management (ANB) Local Farmers Conservation organizations
Primary Water Objective	Water resources quality, Receiving water body quality
Catchment/watershed management or 'End-of-pipe'	Watershed/catchment management, Source water protection, Water resource management
NbS Category	Land management
Co-benefits	Biodiversity, Carbon sequestration, Health benefits, People-based co-benefits (participation, improved resource rights, recreational value)
Solution adopted at scale?	No, but integrated into broader regional water governance

The Case Study

De Watergroep has proactively engaged with farmers, conservation organizations, and regulators to develop catchment-based NbS interventions aimed at reducing agricultural pollution and improving water retention. These include the establishment of buffer strips, cover crops, and soil restoration practices to minimize nutrient runoff and pesticide infiltration. While NbS adoption remains voluntary, De Watergroep has observed increasing stakeholder support as water quality benefits become evident. Pilot projects have demonstrated that NbS implementation reduces nitrate and phosphate pollution by 10% to 15% while enhancing biodiversity and improving soil health. Resistance comes from the farmers because implementing NbS goes against their business model. They are asked to sacrifice productive land.

Relevance to National Context: The initiative aligns with Belgium's obligations under the EU Water Framework Directive (WFD) and regional strategies such as the Flemish Blue Deal, which prioritizes NbS for tackling water scarcity and pollution. The Manure Action Plan (MAP) has sought to limit agricultural pollution since the 1990s, but progress has been slow, necessitating additional interventions. De Watergroep's approach demonstrates how water utilities can act as facilitators of NbS, bridging gaps between policy, land management, and water protection.

Enabling Conditions

Law: Belgium's water legislation is shaped by a combination of EU regulations, Flemish environmental laws, and sector-specific directives. Key legal instruments include the Decree on Integrated Water Policy[2], which promotes NbS for flood

2 Decreet integraal waterbeleid. (2003). https://www.integraalwaterbeleid.be/nl/regelgeving/decreet-integraal-waterbeleid.

management and water conservation, and the VLAREM environmental permits regulation[3], which sets water quality standards. Regulatory alignment with EU directives has further strengthened the legislative support for NbS.

Policy and Regulation: The Flemish Environment Agency (VMM) oversees water quality monitoring and policy enforcement, while the IWRM Coordination Commission (CIW) facilitates integrated water resource management at the regional level. Government-led initiatives such as the Blue Deal have provided a supportive policy environment. However, NbS implementation is often constrained by land-use regulations and permitting complexities, favoring conventional grey infrastructure solutions. Strengthening inter-agency coordination, integrating NbS into urban and agricultural planning frameworks, and improving stakeholder engagement, as demonstrated by De Watergroep's pilot projects, could enhance scalability.

Funding and Finance: De Watergroep finances NbS through a mix of public funding, EU grants, and cost-sharing agreements with provincial governments. Financial incentives for farmers to adopt sustainable land practices have also supported NbS implementation. The Flemish Water Regulator oversees water tariffs, allowing utilities to allocate resources for source water protection. Additional funding sources include EU, national, and Interregional projects. However, long-term financing remains challenging as NbS investments are often classified as operational rather than capital expenditures, limiting eligibility for infrastructure-focused funding streams.

Institutional Arrangements: Water governance in Flanders involves multiple actors, including regional authorities, municipalities, water utilities, and conservation organizations. De Watergroep has leveraged its position to facilitate multi-stakeholder dialogues and integrate NbS into broader water security strategies, enhancing trust and cooperation among landowners. Nonetheless, institutional silos between environmental and agricultural agencies continue to hinder holistic implementation, requiring further collaborative efforts to fully exploit NbS potential.

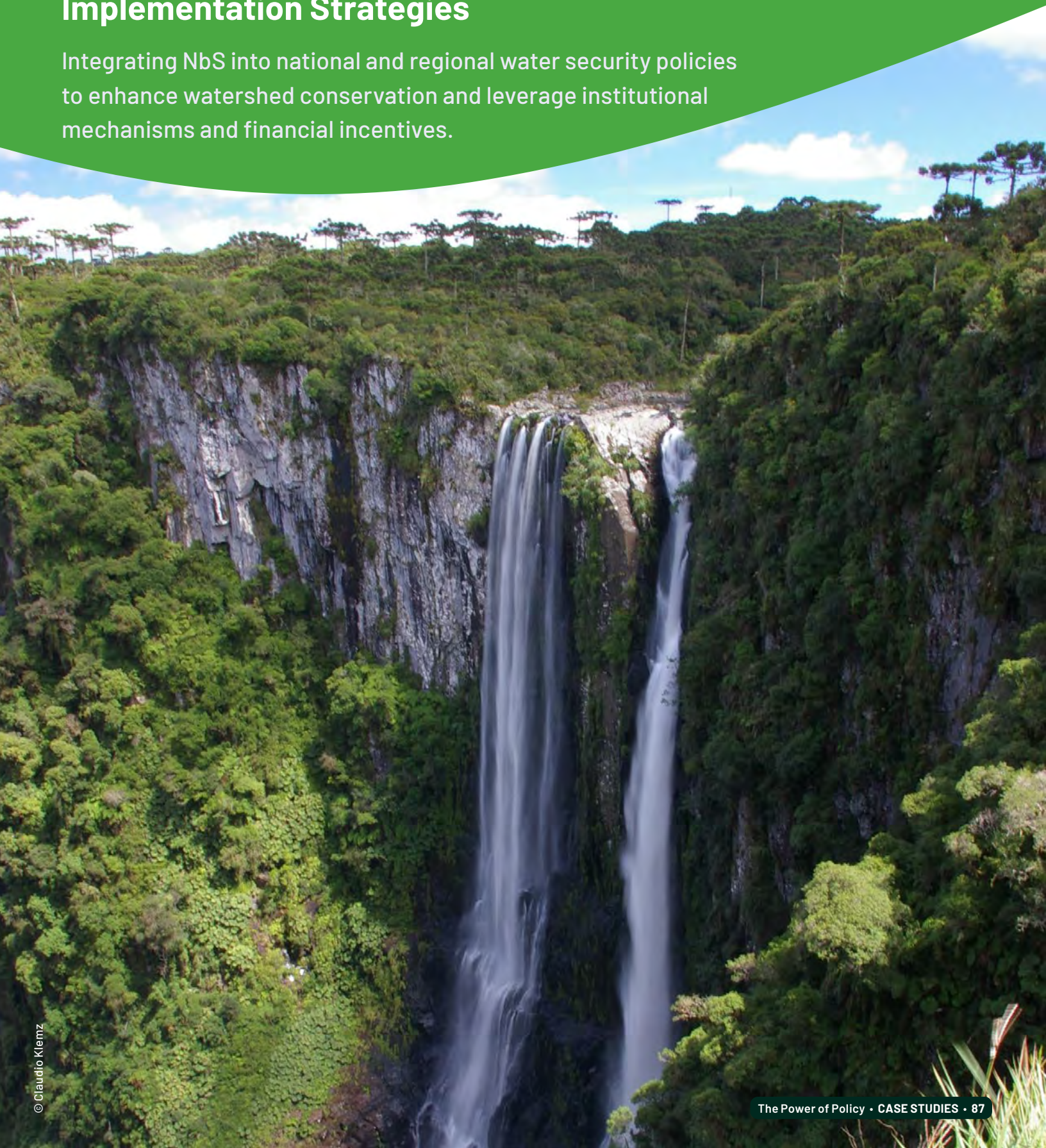
Common Execution Conditions: Implementing NbS in Flanders requires overcoming land-use conflicts, administrative barriers, and economic uncertainties. Farmers often lack sufficient financial incentives to shift toward NbS, despite existing policy support. Regulatory complexities remain significant. To address these challenges, De Watergroep has partnered with a citizen-based nature NGO (Natuurpunt) and the Agency for Nature and Forest Management (ANB), demonstrating economic benefits through pilot projects and expanding conservation efforts within water catchments via public-private cooperation models. In addition, despite increasing awareness, there is still a perception by decision-makers that the grey solutions are more reliable and controllable than NbS. For De Watergroep, this is particularly the case for water treatment, or removal of organic pollution or pesticides, for example.

3 Decree of the Flemish Government of 17 February 2012 establishing the Flemish regulation on sustainable management of material cycles and waste materials. (2012). https://technical-regulation-information-system.ec.europa.eu/it/notification/24121/text/D/E.

Brazil

Institutional Arrangements and Implementation Strategies

Integrating NbS into national and regional water security policies to enhance watershed conservation and leverage institutional mechanisms and financial incentives.



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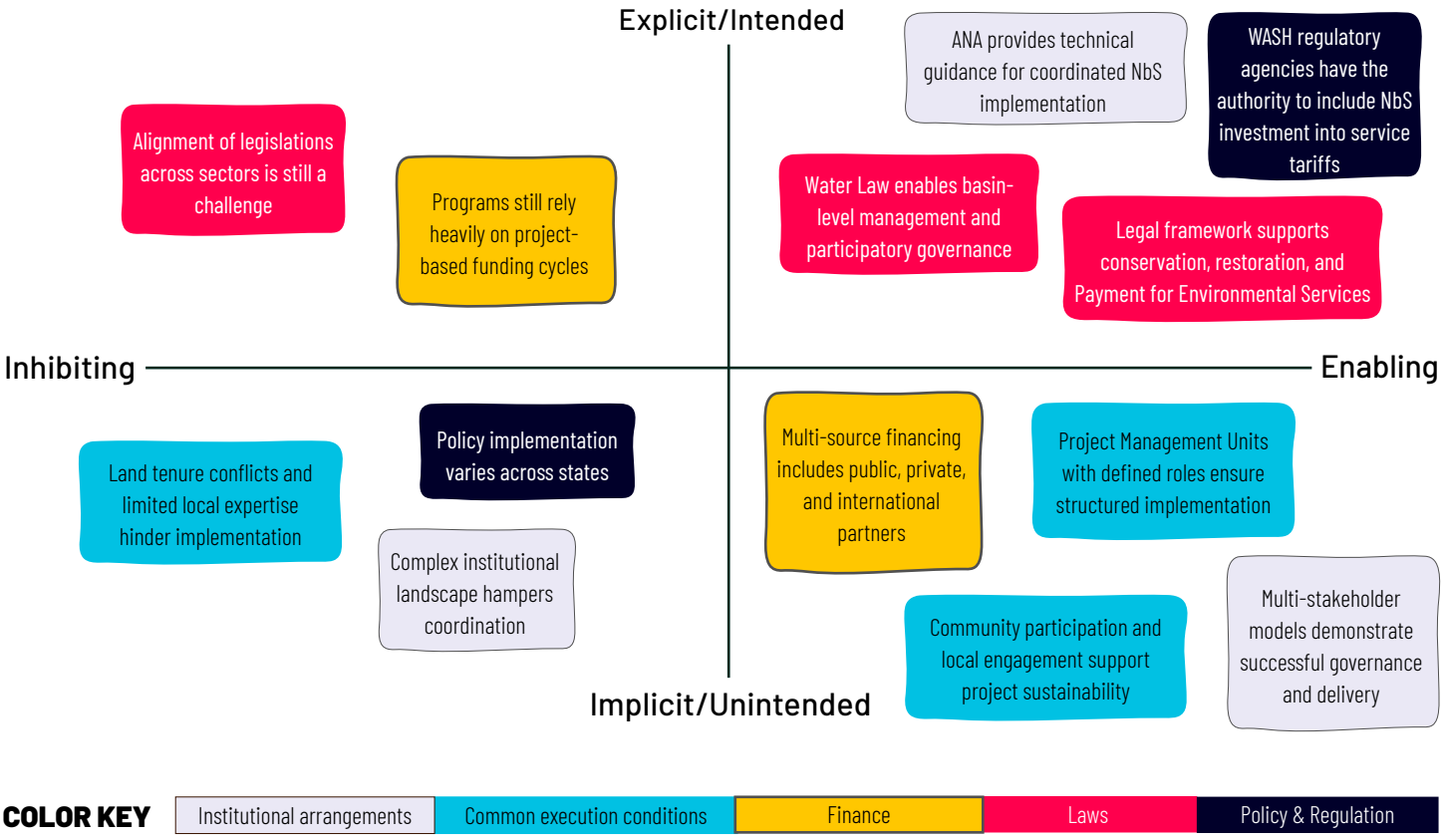
Context

Water Security: Despite having the largest freshwater reserves in the world, Brazil faces significant water security challenges due to climate change, deforestation, pollution, and increasing water demand. The demand for water exceeds availability in several regions of the country, especially in the semi-arid region and the central region, where small and medium-size rivers predominate. The situation is similar in the far south of the country, where flooded rice crops are located. These problems are partly caused by drought events that mainly affect the northeast, south, and southeast regions.[4] Related to water quality, the increase in organic matter and phosphorus concentrations in water bodies—resulting from untreated or inadequately treated domestic and industrial effluents, uncontrolled use of fertilizers, and animal waste, as well as deforestation that accelerates erosion processes—also poses a threat to water security. This is especially critical in densely urbanized areas, rural areas with intensive agricultural activity, and the Northeastern Semi-Arid region, where reservoirs store water for drought periods.[5]

Water Resources Management: Brazil has developed an advanced regulatory and institutional framework for water governance, incorporating NbS into national policies. The National Water Resources Policy (PNRH) (Law 9.433/1997) established Integrated Water Resource Management (IWRM) and a comprehensive framework for water governance, structured around five key instruments: watershed plans, the classification of water bodies into quality classes, the allocation of bulk water use rights, charges on bulk water use, and the Integrated Water Resources Information System. As part of the implementation of the PNRH, the National Water Security Plan (PNSH) and the National Water Resources Plan were established. Their actions are primarily focused on strategic grey infrastructure interventions of regional significance. However, they also recognize the relevance and complementarity of green infrastructure or NbS, among other approaches, for watershed management. River basin committees play a central role in water governance, as they are responsible for approving the watershed management plan, defining mechanisms and rates for water use charges, and promoting practices aimed at protecting and restoring springs and riparian forests, which are essential for water resource conservation.



4 Conjuntura dos recursos hídricos no Brasil 2023: informe anual. (2024). Agência Nacional de Águas e Saneamento Básico. https://biblioteca.ana.gov.br/sophia_web/acervo/detalhe/101813.

5 Atlas esgotos: despoluição de bacias hidrográficas.(2017). Agência Nacional de Águas, Secretaria Nacional de Saneamento Ambiental. https://metadados.snirh.gov.br/geonetwork/srv/api/records/1d8cea87-3d7b-49ff-86b8-966d96c9eb01.

Factsheet Summary	
Main facilitator	National Water and Basic Sanitation Agency (ANA) Ministry of Environment and Climate Change (MMA) Ministry of Integration and Regional Development (MIDR) Ministry of Cities Basin Committees and Agencies Water Utilities The Nature Conservancy
Primary Water Objective	Water resources quality, Water resources quantity, Wastewater discharge quality, Receiving water body quality
Catchment/watershed management or 'End-of-pipe'	Catchment management, Source water protection, Water resource management
NbS Category	Land management, Habitat restoration, Habitat protection
Co-benefits	Flood mitigation, Biodiversity, Carbon/GHG reduction, Economic benefits, Community participation in water governance
Solution adopted at scale?	Yes, through national policies and regional programs

The Case Study

Several institutional programs have successfully integrated NbS into Brazil's water governance.
The Water Producer Program (Programa Produtor de Água),[6] managed by National Water and Basic Sanitation Agency (ANA), aims to implement the Payment for Environmental Services (PES) mechanism, strengthened by the National Policy on PES, whose regulation is still pending. The program seeks to encourage landowners to adopt conservation practices that enhance water retention and reduce sedimentation.
At the regional level, initiatives led by river basin committees, such as those in the Paraíba do Sul River Basin and the São Francisco Basin, among other relevant experiences, support habitat restoration, sustainable agriculture, and wetland conservation to improve water security. State utilities, including COPASA (Minas Gerais State) and EMBASA (Bahia State), have implemented NbS in their watershed management strategies, incorporating ecosystem restoration into water supply planning and, in the case of CAGECE (Ceará State), in a smaller scale, implementing constructed wetlands for wastewater treatment.

Relevance to National Context: Brazil's extensive experience with water governance provides a strong foundation for scaling NbS. Regulation in some cases, particularly at the water and sanitation sector, allows for the integration of conservation costs into water tariffs, while decentralized management through basin committees facilitates localized decision-making. The country has also pioneered the ISH (Water Security Index), a tool that evaluates human, economic, and ecosystem resilience factors to inform policy interventions. However, the complexity of institutional arrangements and inconsistent enforcement of environmental regulations still pose challenges to widespread NbS adoption.

6 Resolução ANA nº 180, de janeiro de 2024. (2024). Agência Nacional de Águas e Saneamento Básico. https://www.gov.br/ana/pt-br/legislacao/resolucoes/resolucoes-regulatorias/2024/180.

Enabling Conditions

Law: Brazil's water legislation is among the most advanced in Latin America. The Water Law (Law 9.433/1997) established water as a public good and recognized its economic value. It also introduced watershed-level management and participatory decision-making through river basin committees, establishing integrated water resource management (IWRM) to promote ecosystem conservation and restoration for water security. Other key laws, such as the National Environmental Policy (Law 6.938/1981), the National Policy on Payment for Environmental Services (Law 14.119/2021), the Climate Change Policy (Law 12.187/2009), and the Forest Code (Law 12.651/2012)—provide legal support for NbS initiatives. The National Sanitation Law (Law 14.026/2020) further supports the integration of natural infrastructure in water and wastewater management. Aligning these policies with the PNRH is essential for water security, requiring integrated management instruments that coordinate environmental conservation and the sustainable use of water resources. However, integrating water resource policies with sectoral policies and plans remains a challenge, demanding ongoing efforts. Despite these strong policies, enforcement remains uneven, particularly in regions with limited institutional capacity.

Policy and Regulation: The National Adaptation Plan aligns NbS with climate resilience objectives, reinforcing the importance of ecosystem services for long-term water security. The National Water Security Plan provides long-term guidance, while the ANA coordinates policy implementation. Brazil has developed regulatory mechanisms to promote NbS adoption, including financial incentives and monitoring requirements. The National Policy on Payment for Environmental Services (Law 14.119/2021) enables water utilities to compensate landowners for conservation efforts, ensuring sustainable watershed management. Basin committees can allocate funds from water use charges to support restoration activities. Additionally, water and sanitation sector regulatory agencies have the authority to include NbS investment costs—aimed at protecting water sources—into service tariffs. However, policy implementation varies across states, with some regions lacking the technical capacity to execute large-scale NbS programs effectively.

Funding and Finance: Financing for NbS in Brazil comes from a mix of public and private sources, following models similar to water funds. The financing arrangements in various programs aim to mobilize resources from multiple sources where even, in some cases, the in-kind technical capacities of Project Management Unit members also add up to the financing structure. For example, the Water Producer Program initially provided direct financial subsidies through ANA. However, with the involvement of multiple institutions contributing within their own budget frameworks, the program's role has evolved into facilitating resource mobilization for project support. Funding sources include:

- State water and environmental Funds
- National Environmental Fund
- International banks and organizations (e.g., NGOs, GEF, etc.)
- Sanitation and energy companies, industries, and water users
- Water use charges
- Financial compensation from beneficiaries
- Clean development mechanisms

However, gaps remain in ensuring long-term financial sustainability, particularly in securing continuous investment beyond project-based funding cycles. To mobilize investment in sustainable infrastructure, the Ministry of Regional Development developed an open-access tool to classify Environmental, Social, and Governance (ESG) projects by sector (e.g., water and sanitation), sub-sector, and project cycle stage. The tool assesses project quality and sustainability, using clear, measurable, and recognized impact criteria. This enhances transparency, mitigates risks, boosts investor confidence, and helps prevent greenwashing.[7]

Institutional Arrangements: The institutional landscape for NbS implementation in Brazil is complex, involving federal, state, and municipal agencies, as well as private water utilities and river basin committees. The ANA provides technical guidance, while municipalities, local water agencies and utilities execute conservation programs. Successful and relevant

7 Taxonomias e frameworks ASG para o saneamento e a infraestrutura hídrica: instrumentos para mobilizar investimentos e expandir a infraestrutura sustentável no Brasil. (2022). Ministério de Desenvolvimento Regional (Brasil). https://www.gov.br/mdr/pt-br/assuntos/seguranca-hidrica/FSBTaxonomiaseFrameworksASGparaSaneamentoealnfraestruturaHidrica_compressed1.pdf.

cases, such as the Water Producer Program (ANA's Program), the Pró-mananciais[8] (COPASA's Program in Minas Gerais), and the São Francisco Basin Restoration Program,[9] share a common governance structure that requires a Project Management Unit, with clearly defined responsibilities for the involved parties, as well as criteria for project selection and structuring. They demonstrate the effectiveness of multi-stakeholder collaboration in scaling NbS. Strengthening institutional coordination and capacity-building programs for water managers will be key to maximizing NbS benefits.

Common Execution Conditions: A recurring key factor across all programs is the fundamental role of community participation, the engagement of local leaders, and the delegation or hiring of local services to ensure the success and continuity of actions. Additionally, the involvement of municipal governments is considered crucial for the effective implementation of these programs. Challenges include bureaucratic complexity, land tenure conflicts, and varying levels of local technical expertise. While financial mechanisms exist, limited enforcement of conservation requirements and inconsistent stakeholder engagement can hinder project success. Consistent long-term results monitoring is required in many ongoing programs. Addressing these challenges requires targeted investments in training, governance structures, and improved monitoring systems to demonstrate the cost-effectiveness of NbS compared to grey infrastructure solutions.

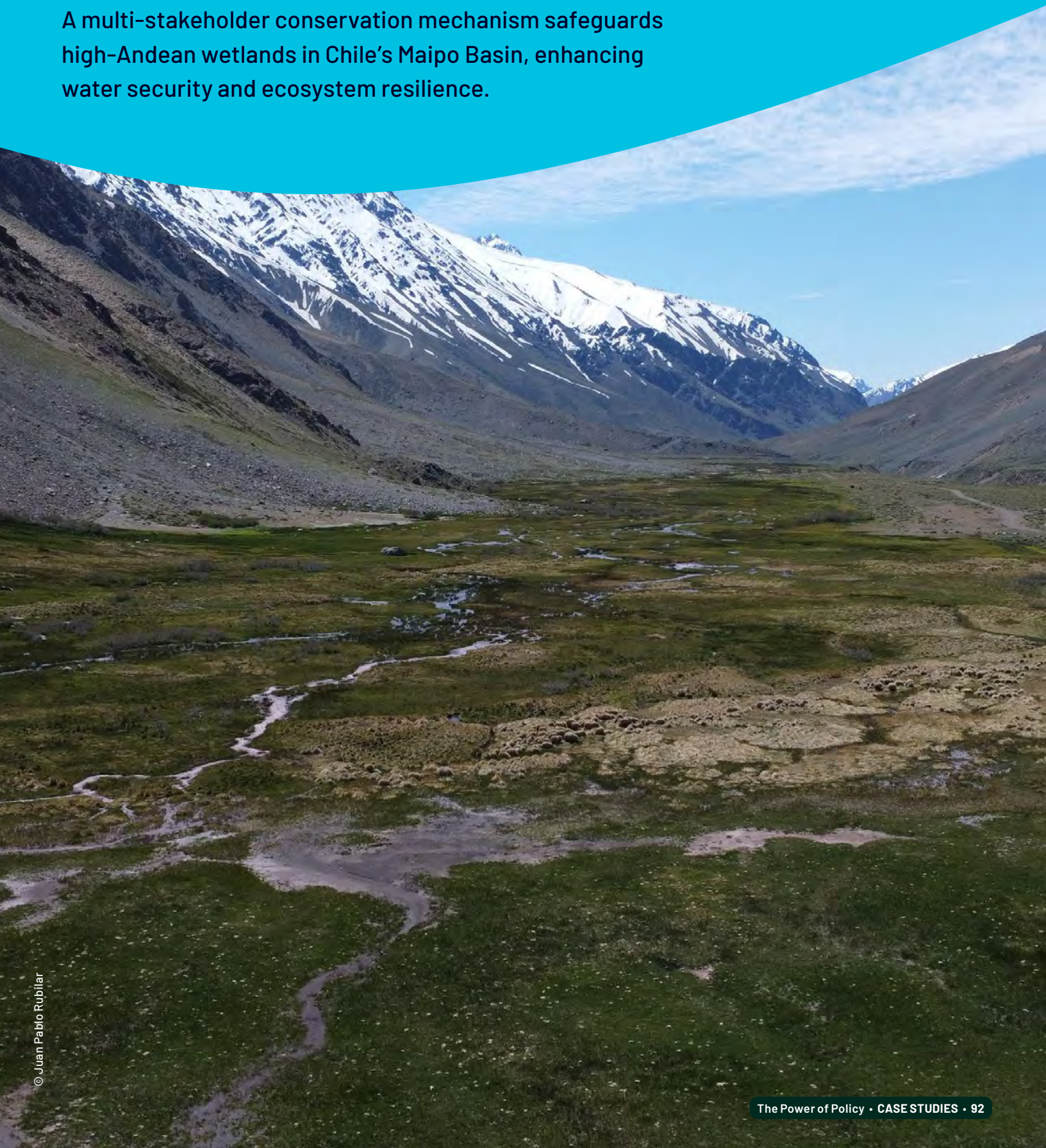
8 https://promananciais.copasa.com.br/.

9 Manual Operativo do Programa de Conservação e Recuperação Ambiental da Bacia Hidrográfica do Rio São Francisco. 1ª edição. (2022). Comitê da Bacia Hidrográfica do Rio São Francisco (CBHSF). https://cdn.agenciapeixevivo.org.br/media/2023/07/Manual-Operativo-Programa-de-Conservacao-e-Recuperacao-Ambiental-da-Bacia-Hidrografica-do-Rio-Sao-Francisco.pdf.

Chile

The Maipo Basin Wetland Conservation Initiative

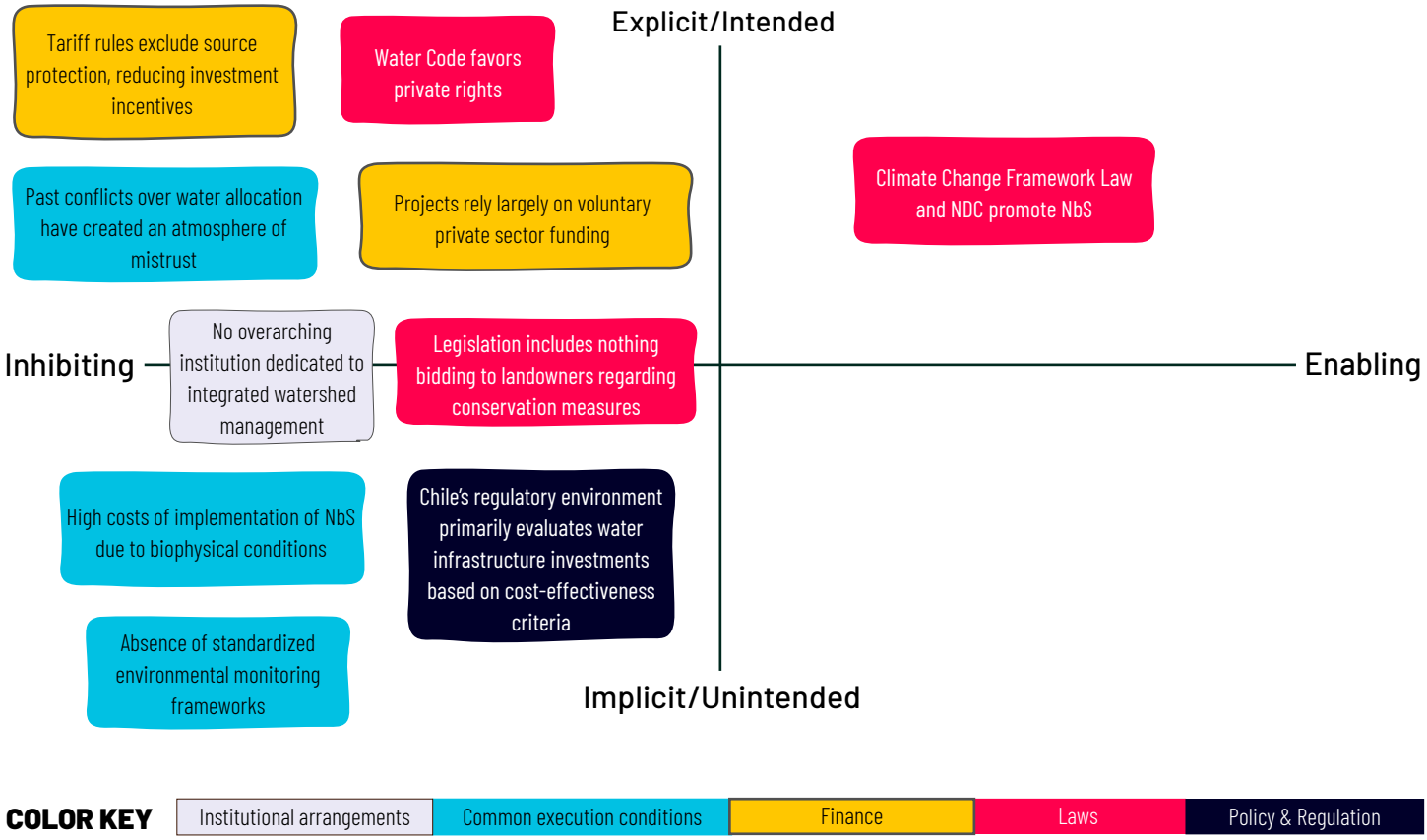
A multi-stakeholder conservation mechanism safeguards high-Andean wetlands in Chile's Maipo Basin, enhancing water security and ecosystem resilience.



Context

Water Security: Chile is the most water-stressed country in the Americas and the only Latin American country projected to experience extremely high-water stress by 2040.[10] Water management in Chile is dominated by a privatized Water Use Rights (WUR) system, limiting public intervention and integrated watershed governance. The lack of watershed-level management results in weak coordination between actors and hinders long-term water security. Climate change further exacerbates water scarcity, with prolonged droughts, declining groundwater levels, and increasing competition among sectors like agriculture, industry, and urban water supply.

Water Resources Management: Chile's legal framework historically prioritized the economic value of water over environmental and social considerations. However, recent reforms have sought to integrate NbS into water governance. The Climate Change Framework Law[11] formally defines and incorporates NbS into national adaptation and mitigation plans. Chile's Nationally Determined Contribution[12] (NDC) and Long-Term Climate Strategy (ECLP 2050)[13] recognize NbS as key mechanisms for climate resilience, supporting green infrastructure and integrated watershed management. Despite these advancements, implementation barriers persist due to regulatory gaps, weak institutional coordination, and a lack of financial incentives for NbS adoption.



10 Aqueduct: Using cutting-edge data to identify and evaluate water risks around the world. (2023). World Resources Institue. https://www.wri.org/aqueduct.

11 Climate Change Framework Law, Number 21.455. (2022). Government of Chile. https://www.bcn.cl/leychile/navegar?idNorma=1177286.

12 Fortalecimiento de la Contribución Determinada a Nivel Nacional (Nationally Determined Contribution. (2022). Ministry of the Environment, Chile. https://cambioclimatico.mma.gob.cl/wp-content/uploads/2023/01/Chile-Fortalecimiento-NDC-nov22.pdf.

13 Estrategia Climática de Largo Plazo de Chile (Long-Term Climate Strategy). (2021). Ministry of the Environment, Chile. https://cambioclimatico.mma.gob.cl/wp-content/uploads/2021/11/ECLP-LIVIANO.pdf.

Factsheet Summary	
Main facilitator	Ministry of Environment Ministry of Agriculture The Nature Conservancy – Chile Santiago Water Fund Private landowners Andean Waters
Primary Water Objective	Water resources quality, Water resources quantity
Catchment/watershed management or 'End-of-pipe'	Source water protection, Water resource management
NbS Category	Habitat protection, Habitat restoration
Co-benefits	Biodiversity, Carbon/GHG
Solution adopted at scale?	No, but pilot initiatives and growing interest

The Case Study

The Highland Wetland Conservation Initiative, implemented in the Maipo River Basin, is a pioneering multi-stakeholder effort to restore and protect 180 hectares of high-Andean wetlands and the creation of new private area across a new private nature sanctuary spanning 95,000 hectares on the highland water source. This declaration plays a relevant role in safeguarding private areas under conservation, expanding national land protection, and increasing the water security for the Maipo basin, with the protection of wetland and river on the top of water sources. Led by TNC and the Santiago Water Fund, the project engages private landowners, government agencies, and multinational companies committed to environmental sustainability. The wetland was selected due to its high vulnerability to drought, its importance for biodiversity, and its role in securing water supply for Santiago, Chile's largest city. The project aims to enhance water retention, improve ecosystem health, and serve as a model for NbS adoption in a highly privatized water governance landscape.

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Relevance to National Context: The Maipo Basin is home to Santiago, a city of nearly 8 million people that generates more than 40% of Chile's GDP. Rapid urban expansion and increasing water demand place significant stress on the basin's resources. The initiative aligns with national and regional priorities for climate adaptation and water security, demonstrating how NbS can contribute to both ecological restoration and economic resilience. However, the absence of formalized basin governance and the predominance of private water rights present challenges for scaling similar initiatives nationwide.

Enabling Conditions

Law: Chile's legal framework provides a mixed landscape for NbS adoption. While the Climate Change Framework Law and NDC promote NbS, the country's Water Code (1981)[14] prioritizes private water rights, making it difficult to allocate resources for conservation. Recent reforms from 2022[15] have introduced public interest considerations into water management, allowing for limited restrictions on WURs in cases of basin-wide sustainability threats. However, these changes are not retroactive, meaning

14 Water Code. (1981). Ley Chile. https://www.bcn.cl/leychile/navegar?idNorma=5605.

15 Water Code Reform, Law 21.435. (2022). Ley Chile. https://www.bcn.cl/leychile/navegar?idNorma=1174443.

that many basins remain over-allocated beyond their actual water availability, complicating efforts to revert water and land uses and implement NbS effectively. Additionally, voluntary cooperation from private landowners has been essential, as land tenure laws in Chile make it difficult for the state to enforce conservation measures without explicit owner consent.

Policy and Regulation: The lack of binding policies mandating NbS adoption remains a barrier. Chile's regulatory environment primarily evaluates water infrastructure investments based on cost-effectiveness criteria, making it difficult for NbS to compete with conventional grey solutions. The concessions for drinking water are indefinite and operate through private companies, in a single monopoly market system.

Funding and Finance: Financing remains a critical challenge for NbS implementation in Chile. Water tariffs are regulated by the Supreme Decree MOP No. 70/88,[16] which does not incorporate the possibility for service providers to include source protection and wider water security actions in tariffs, further limiting incentives for private sector investment in watershed conservation. While tax mechanisms such as Law 20.780 (2014)[17] allow for pollution offset initiatives, there is no dedicated policy framework to integrate NbS into mainstream water management. The Highland Wetland project relies on voluntary contributions from private sector actors, as no formal public funding mechanisms exist for NbS. While the government is exploring the inclusion of natural capital in corporate financial reporting, this has yet to translate into concrete financial incentives. Potential funding avenues include carbon credit markets, tax incentives for conservation investments, and the establishment of regional water funds to pool resources for NbS at scale.

Institutional Arrangements: The project's success relies on collaboration between multiple stakeholders, including government agencies, private landowners, research institutions, and civil society organizations. However, Chile lacks an overarching institution dedicated to integrated watershed management. The recent announcement of the Maipo River Basin Organization (2024) represents a step toward coordinated water governance, but it currently lacks regulatory authority and sustainable financing mechanisms. Strengthening institutional frameworks for multi-sectoral cooperation and basin-based planning will be essential for scaling NbS in Chile.

Common Execution Conditions: Several challenges hinder the broader implementation of NbS in Chile. The high costs of ecosystem restoration, particularly in arid and semi-arid regions, make NbS projects financially demanding compared to other Latin American countries. The absence of standardized environmental monitoring frameworks limits the ability to quantify NbS benefits, reducing investor confidence. Additionally, historical conflicts over water allocation have created an atmosphere of mistrust among stakeholders, complicating collaborative efforts. Addressing these challenges requires stronger regulatory frameworks, dedicated financing mechanisms, enhanced cooperation and improved technical capacity for NbS design and implementation. Key enablers of the Highland Wetland initiative include strong leadership from TNC, which provides vision, coordination, and technical expertise.

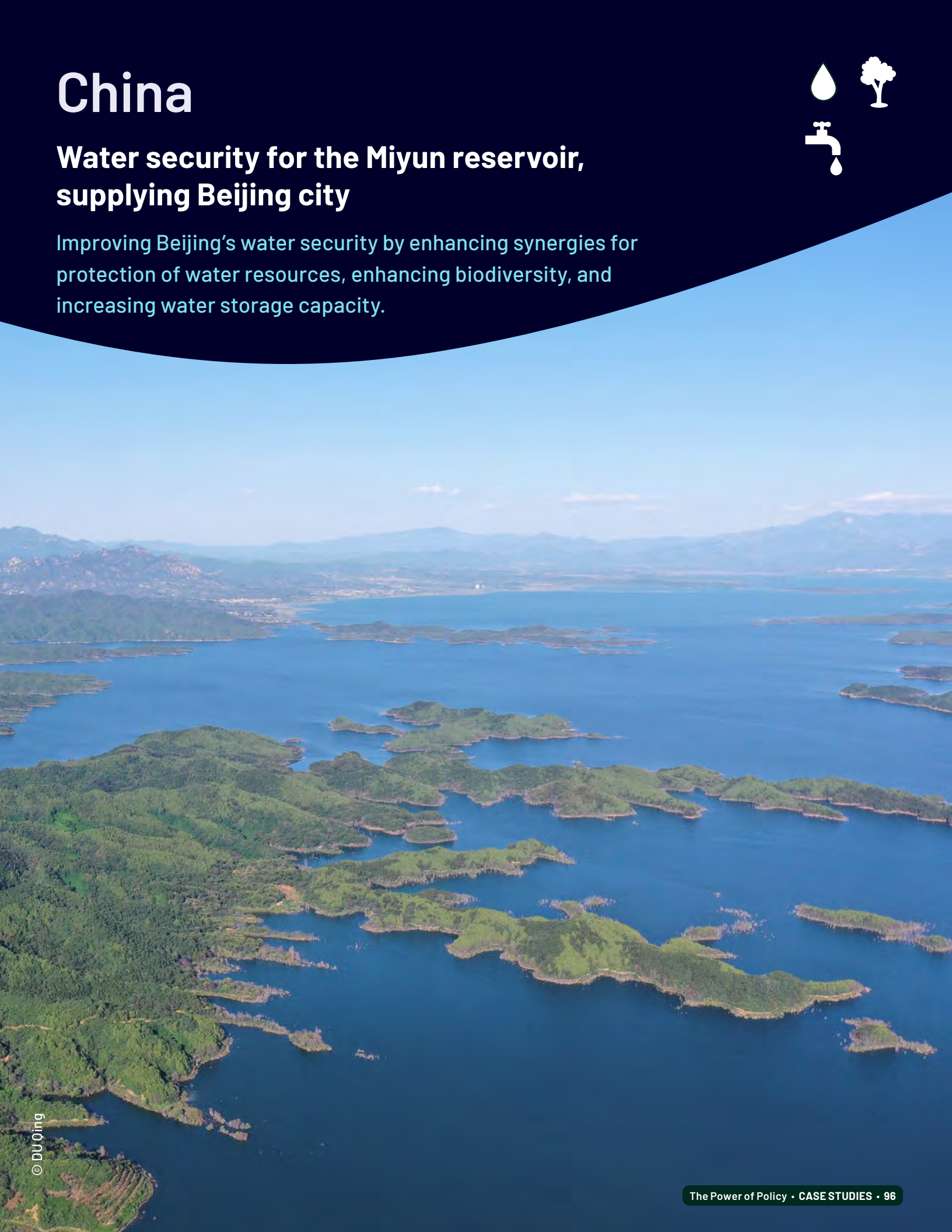
16 Supreme Decree 70. (1988). Ley Chile. https://www.bcn.cl/leychile/navegar?idNorma=4427.

17 Reform of the Tax Law. (2014). Ley Chile. https://www.bcn.cl/leychile/navegar?idNorma=1067194.

China

Water security for the Miyun reservoir, supplying Beijing city

Improving Beijing's water security by enhancing synergies for protection of water resources, enhancing biodiversity, and increasing water storage capacity.



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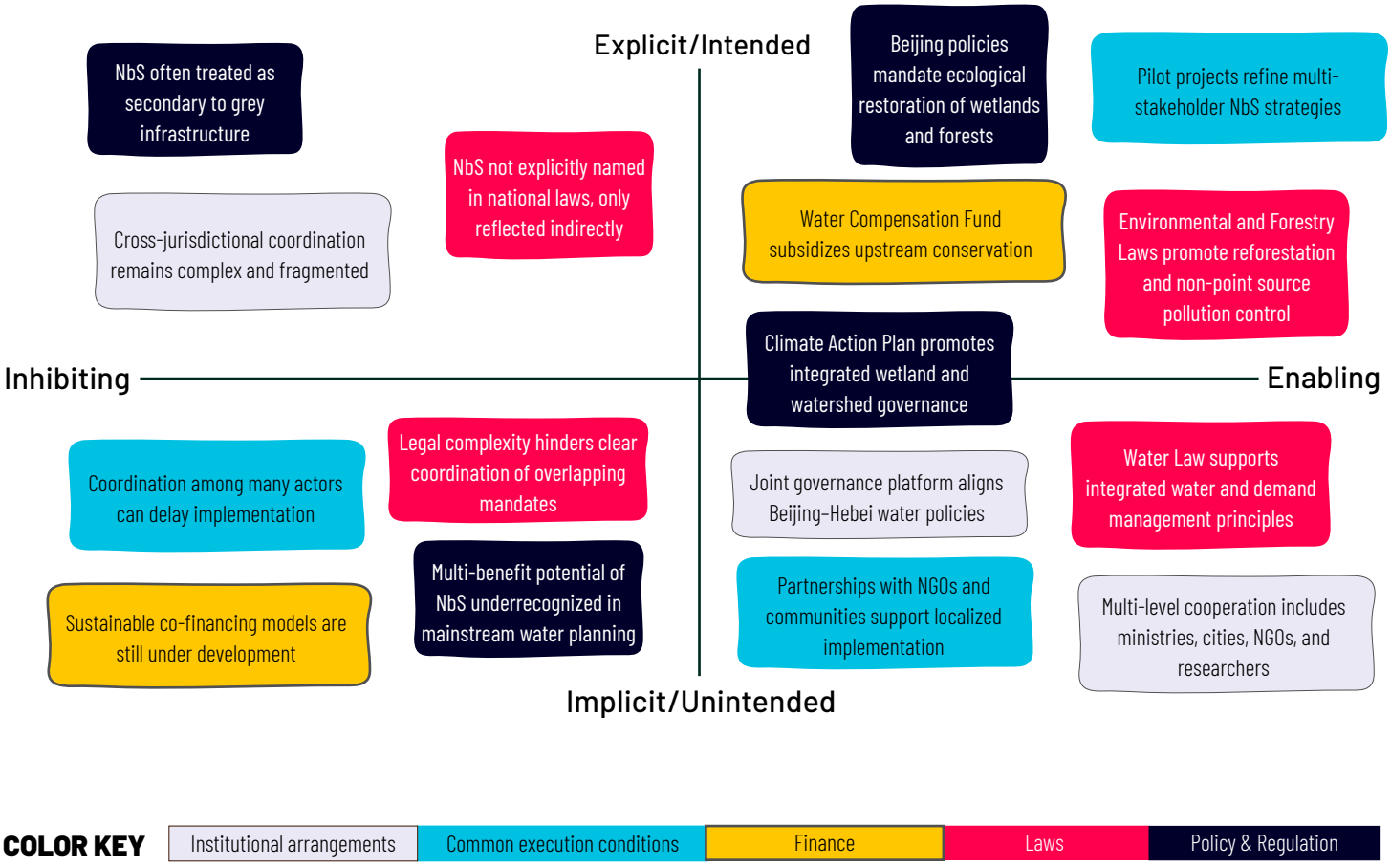
Context

Water Security: China faces severe water security challenges due to spatially uneven water distribution and increasing demand from rapid industrialization and urbanization.[18] Northern China, where Beijing is located, suffers from chronic water shortages, with per capita freshwater availability among the lowest in the world. Miyun Reservoir, the largest reservoir in North China, supplies up to 70% of Beijing's domestic water before the South-to-North Water Diversion Project's Middle Route went into operation and now has become the Strategic Water Resource Base for Beijing, acting as the "stabilizer" and "regulator" for the capital's water security and an "invaluable asset" for biodiversity and diverse ecosystem services.[19] However, despite the supplementary water supply from the south, the severe trend of water resource decline in North China due to climate change, the historical issues of long-term overexploitation of groundwater and rivers in Beijing, and the increasing demands for water resources, water ecology, and water environment due to urban development are making water security a top priority for the capital.[20]

Water Resources Management: China's water governance follows a hierarchical approach, with national policies set by the Ministry of Water Resources and implementation carried out at provincial and local levels. In 2014, the South-to-North Water Diversion Project began channelling water from the Danjiangkou Reservoir to Miyun Reservoir, significantly increasing Beijing's water supply. However, long-term sustainability requires enhanced watershed management, pollution control, and ecological restoration to maintain water quality and quantity. NbS have emerged as a complementary strategy alongside large-scale infrastructure projects to improve water security.



18 State of Ecology and Environment Report. (2023). MEE. https://www.mee.gov.cn/hjzl/sthjzk/zghjzkgb/202406/P020240604551536165161.pdf.

19 Donnellon-May, G. (2022, December 17). China's five-year national water security plan: How does China's first five-year plan for national water security attempt to tackle the country's most pressing water challenges? The Diplomat. https://thediplomat.com/2022/12/chinas-five-year-national-water-security-plan/.

20 Xi Jinping replied to the villagers who build ant guarded the Miyun Reservoir. https://www.gov.cn/xinwen/2020-08/31/content_5538700.htm#:~:text=.

Factsheet Summary	
Main facilitator	Government Authorities: Beijing Water Authority/Beijing Miyun Reservoir Management Administration, Beijing Municipal Forestry and Parks Bureau, Beijing Municipal Government of Miyun District Upstream Stakeholders: Hebei Municipal Government NGOs: Beijing Miyun Reservoir Protection Foundation, The Nature Conservancy Local Community: Farmers
Primary Water Objective	Water resources: Quality and quantity
Catchment/watershed management or 'End-of-pipe'	Catchment/watershed management
NbS Category	Land management
Co-benefits	Biodiversity, Carbon sequestration, Health benefits, People-based co-benefits (participation, improved resource rights, recreational value)
Solution adopted at scale?	No, but integrated into broader regional water governance

The Case Study

To protect the capital's strategic water source, local authorities have implemented a wide range of NbS measures, including wetland restoration, reforestation, pollution control and small watershed conservation and water ecology protection. By 2021, these measures contributed to stabilizing water quality at the Surface Water Class II standard, the required threshold for drinking water sources, while improving biodiversity.[21] In addition, local authorities are also actively exploring NbS for water security with multi-benefits. These include the Beijing Miyun Watershed Multi-functional Forest Management Project, initiated by the Beijing Municipal Forestry and Parks Bureau in cooperation with TNC. This project aims to enhance water retention capacity, biodiversity, and climate resilience of the forests across the entire watershed through the demonstration of NbS interventions. The project team is also working with local communities to conserve critical bird habitats and demonstrate a bird-watching economy in the watershed, which not only further enhances water security but also promotes biodiversity.[22]

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Relevance to National Context: Miyun Reservoir's protection aligns with China's broader push toward an "Ecological Civilization," a development model that integrates environmental sustainability with economic growth. In January 2022, China released a plan to improve the country's capability to safeguard its water security under the 14th Five-year Plan period (2021-2025),[23] This was titled the "14th Five Year Plan for Water Security."[24]The Plan prioritizes NbS for improving water resilience while the Beijing Water Security Plan (2020–2035) includes ecosystem-based water management strategies. The protection of Miyun Reservoir is also guided by specific regional plans. The Beijing Miyun Reservoir Basin Water Ecological Protection and Development Plan (2021-2035) and the Beijing Miyun Reservoir Upstream Area Spatial

21 Beijing Water Resources Security Plan, 2020-2035. (2022). Beijing Water Affairs Bureau.

22 Miyun Reservoir. https://www.mee.gov.cn/home/ztbd/2021/mlhhyxalzjhd/yxal/202201/t20220127_968333.shtml.

23 NPC & CPPCC Annual Sessions 2021. (2021). http://www.xinhuanet.com/fortune/2021-03/13/c_1127205564.htm.

24 14th Five Year Plan for Water Security. (2022, January 1). UN Environment Programme. https://leap.unep.org/en/countries/cn/national-legislation/14th-five-year-plan-water-security.

Protection Plan (2021-2035)[25] have been formulated to enhance the water ecological environment and ensure sustainable development in the region. These policies recognize that large-scale grey solutions alone cannot ensure long-term water security, necessitating a shift toward integrated, nature-based approaches.

Enabling Conditions

Law: Although the specific term "Nature-based Solutions" has not been explicitly mentioned in the national-level laws at present, the relevant concept has been reflected in legislation documents. The Water Law (revised 2016)[26] reflects current thinking on integrated water resource and demand management. It enshrines the constitutional principles that everyone should have access to safe water, and that water conservation and environmental protection are governmental priorities. The Environmental Protection Law (revised 2025)[27] strengthens non-point pollution control measures through agricultural Best Management Practices (BMPs), while the Forestry Law (2019)[28] supports afforestation and forest management efforts to improve water conservation. The Prevention and Control of Water Pollution Law (revised 2025) encourages constructing artificial wetlands, water source conservation forests, and vegetation buffer zones along rivers and lakes to improve ecological functions and ensure water safety. The Wetlands Conservation Law (2022) has structured legal and financial frameworks to drive investment in wetland conservation (special provisions for mangroves and peat bogs) by integrating ecological priorities with economic incentives. The Water and Soil Conservation Law of China (2011)[29] is formulated to prevent and control water and soil loss, protect and reasonably utilize water and soil resources, reduce floods, droughts and sandstorms, improve the ecological environment and guarantee sustainable economic and social development.

Policy and Regulation: Beijing has enacted several policies and regulations to enhance water source conservation and water security through NbS.[30] The Beijing Municipal Regulation on Ecological Conservation and Green Development in Ecological Conservation Areas (2021)[31] focuses on protecting key water sources like the Miyun Reservoir through ecological restoration measures such as restoring "eco-clean" small watersheds and wetlands. The Beijing's 14th Five-Year Plan for Ecological and Environmental Protection (2021)[32] includes pilot projects for river and lake ecological buffer zone restoration and water ecosystem rehabilitation in the Miyun Reservoir catchment to prevent pollution and enhance water security. The Beijing Municipal Water Pollution Prevention and Control Regulation (revised 2021)[33] mandates the construction of wetlands and water source conservation forests to prevent pollution inflows into drinking water bodies. The Beijing Climate Change Adaptation Action Plan (2024)[34] promotes the restoration and integrated management of wetlands in key areas. The Beijing Forest Land Protection and Utilization Plan (2021—2035)[35] advances systematic governance of mountains, rivers, forests, farmlands, lakes, and grasslands to enhance forest water source conservation functions.

These policies and regulations indicate that Beijing is gradually integrating NbS into mainstream planning and management for water source conservation and water security enhancement. Through the protection and restoration of ecosystems such as forests and wetlands, the sustainable use of water resources is being achieved. However, while NbS are recognized in Beijing's water resource conservation, water resource planning still prioritizes large-scale infrastructure projects, with NbS often treated as supplementary measures. The multiple benefits of NbS in water security remain to be fully recognized in mainstream planning, and investment in NbS for water security also remains to be strengthened. The local authorities, Beijing Municipal Forestry and Parks Bureau and Beijing Water Authority, are working with TNC and institutes to further understand the multi-benefits that NbS can bring to the Miyun Reservoir Catchment regarding to water security, biodiversity conservation, and local green development through researching and piloting. This aims to develop a model that can enhance local water security and biodiversity conservation in a more cost-effective way.

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25 The spatial development plan was officially issued to achieve a healthy and stable ecosystem pattern by 2035. Fourteen nature reserves have been designated in the upper reaches of the Miyun Reservoir. https://www.beijing.gov.cn/ywdt/gzdt/202305/t20230504_3085339.html.

26 Water Law of the People's Republic of China (Revision). (2009). http://www.mwr.gov.cn/english/Documents/LawsAndRegulations/202311/P020231102633392643585.pdf.

27 Environmental Protection Law of the People's Republic of China. (1989). https://leap.unep.org/en/countries/cn/national-legislation/environmental-protection-law-peoples-republic-china.

28 Forestry Law of the People's Republic of China. (2019). https://leap.unep.org/en/countries/cn/national-legislation/forestry-law-peoples-republic-china-2019.

29 Water and Soil Conservation Law of the People's Republic of China. (2011). https://faolex.fao.org/docs/pdf/chn23747.pdf.

30 The leaders of the bureau organized and held the implementation promotion meeting of the "Beijing Miyun Reservoir Basin Water Ecological Protection and Development Plan." https://swj.beijing.gov.cn/swdt/ztzl/hczzl/zydt/202203/t20220323_2637212.html.

31 Regulations on Ecological Protection and Greed Development of Ecological Conservation Areas of Beijing. https://www.gov.cn/xinwen/2021-04/22/content_5601288.htm.

32 Notice of the Beijing Municipal People's Government on Printing and Distributing the "Beijing Municipal Plan for Ecological and Environmental Protection during the 14th Five-Year Plan Period." https://www.beijing.gov.cn/zhengce/zhengcefagui/202112/t20211210_2559052.html.

33 Beijing Municipal Regulations on the Prevention and Control of Water Pollution. https://www.beijing.gov.cn/zhengce/dfxfg/ 202111/t20211103_2527940.html.

34 Notice on the issuance of the "Beijing Municipal Action Plan for Adaptation to Climate Change." https://yllhj.beijing.gov.cn/zwgk/ghxx/gh/202408/P020240802571101800505.pdf.

35 Forestry Law of the People's Republic of China. (2019). https://leap.unep.org/en/countries/cn/national-legislation/forestry-law-peoples-republic-china-2019.

Funding and Finance: The Miyun Reservoir ecological protection efforts are financed through a mix of public investments, private sector contributions, and international partnerships.[36] The Beijing-Hebei Water Compensation Fund, which allocates payments to upstream conservation efforts, has provided more than 1.95 billion yuan[37] in ecological subsidies since 2018. Multilateral institutions, such as the World Bank and Asian Development Bank, have also supported nature-based water management projects in China. Drawing on global experience in resilient watershed management,[38] including the establishment of two water funds in China, TNC is exploring the possibility of innovative financing models in the Miyun Reservoir Catchment with local stakeholders to achieve a more sustainable, multi-stakeholder participatory water source management cooperation mechanism.

Institutional Arrangements: The State Council of the People's Republic of China directs several ministries, agencies, and commissions involved in water management. The Ministry of Water Resources (MWR) manages all administration concerning water quantity in China. Urban water supply is the responsibility of cities. Services are usually provided by municipally owned water bureaus and wastewater bureaus. The governance of Miyun Reservoir involves multiple stakeholders, including the Beijing Municipal Government, Hebei Provincial Authorities, research institutions, and conservation organizations. The complexity of cross-jurisdictional coordination has posed challenges, particularly in aligning conservation goals with economic development interests. However, the establishment of a joint water governance platform between Beijing and Hebei has facilitated policy coordination and management for NbS interventions.[39]

Common Execution Conditions: Implementing NbS at scale in the Miyun Reservoir watershed has required overcoming several challenges, including overlapping management among multiple parties, coordination between upstream and downstream stakeholders, sustainable funding for NbS, and a standardized monitoring system for evaluating NbS effectiveness to enable adaptive management. In response, authorities have introduced pilot projects in collaboration with multiple partners—such as NGOs, research institutions, local communities, and upstream governments—to refine NbS implementation strategies.[40]

36 Sino-German financial cooperation. https://swj.beijing.gov.cn/swdt/swyw/202008/t20200818_1985176.html.

37 Approximately 138M USD.

38 China's new opportunity: Water funds. (2016). https://web.archive.org/web/20240720151241/https://iwa-network.org/chinas-new-opportunity-water-funds/.

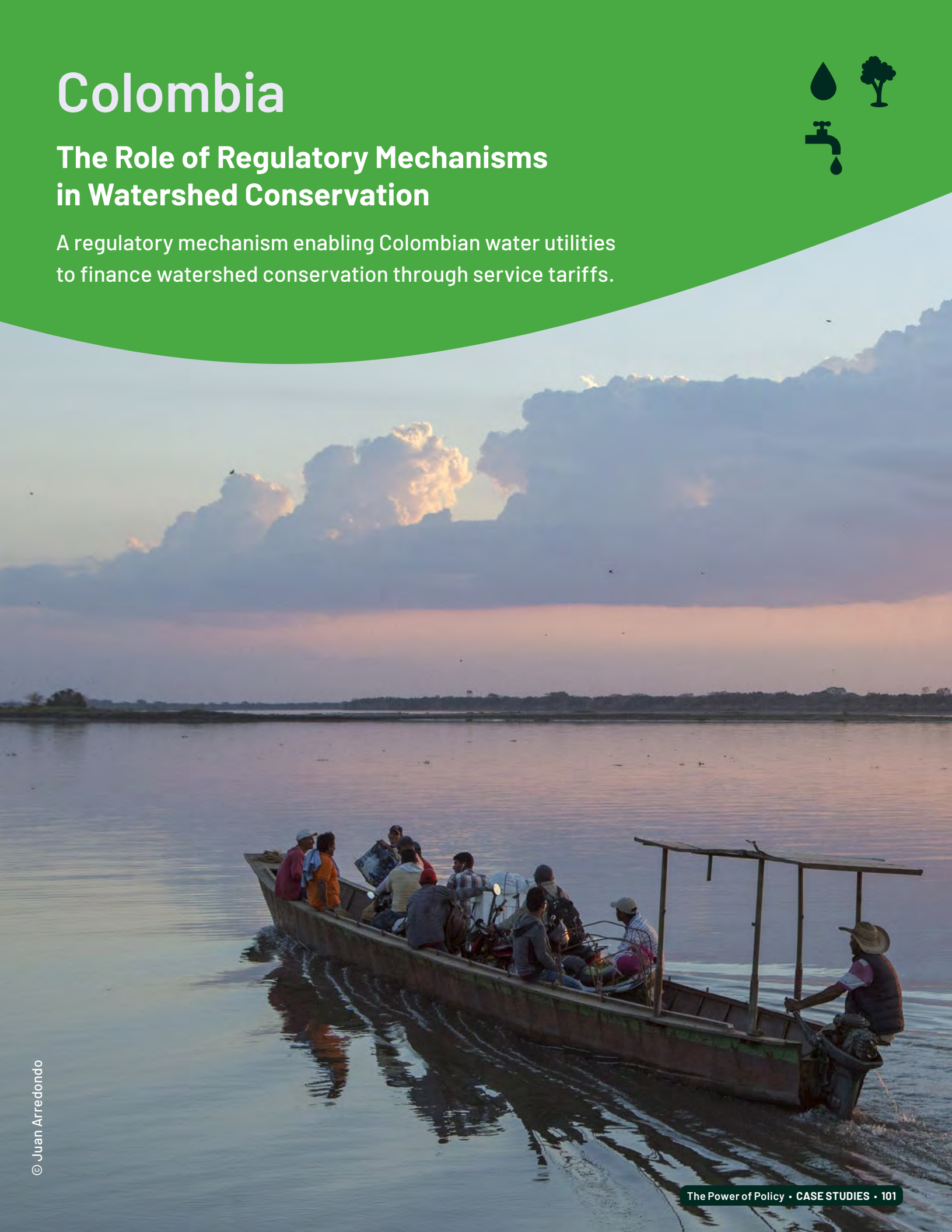
39 The 2024 Beijing-Hebei Miyun Reservoir Water Source Protection Joint Conference was held. https://mp.weixin.qq.com/s?__biz=MzA4MzE2NzQ5Mw==&mid=2650530225&idx=1&sn=79a6516daba6be4f0610f174748141bc&chksm=860b9585b7b55d9c61c98f92bd36fb1f9ffb45a06ecde6ab9ef224b34716b316d08051a784c8&scene=126&sessionid=1729584615#rd.

40 The Municipal Landscape Bureau and TNC signed a memorandum of understanding and officially launched the cooperation. https://www.beijing.gov.cn/ywdt/gzdt/202303/t20230323_2943102.html.

Colombia

The Role of Regulatory Mechanisms in Watershed Conservation

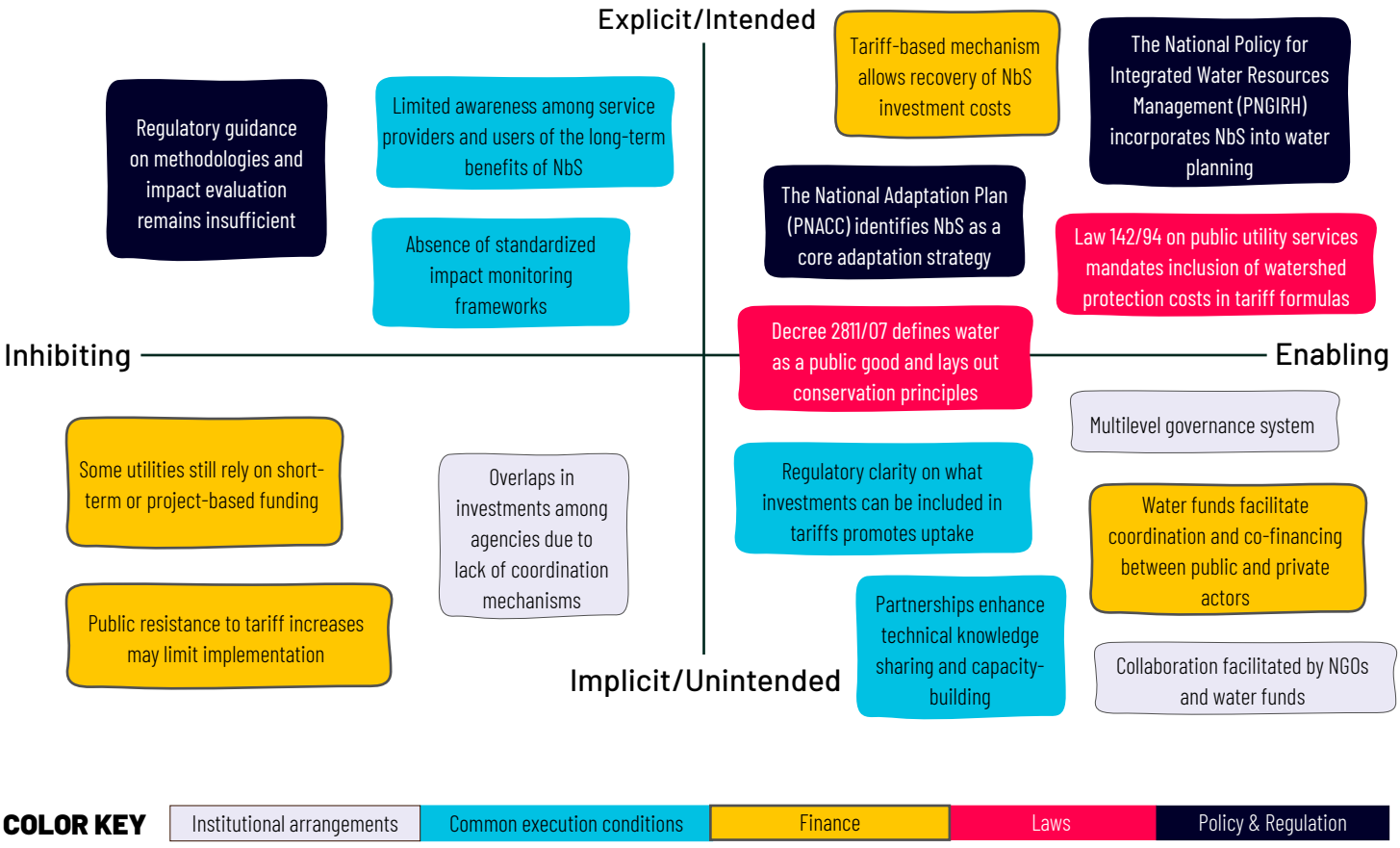
A regulatory mechanism enabling Colombian water utilities to finance watershed conservation through service tariffs.



Context

Water Security: Colombia is one of the most water-rich countries in the world, yet significant water security challenges persist due to climate change, pollution, deforestation, and urban expansion. Extreme weather events, including droughts and floods, have intensified in recent decades, affecting water availability and quality. From 1998 to 2021, more than 800 municipalities faced severe water supply disruptions due to climatic and hydrological variability.[41] In 2024, the El Niño phenomenon led to critically low water levels in 277 municipalities, forcing water rationing in 82 of them.[42] The increasing pressure on both surface and groundwater resources underscores the need for proactive watershed conservation to maintain long-term water security.

Water Resources Management: Water resource management is regulated by the Colombian General Law on the Environment,[43] which designates the entities responsible for environmental and renewable natural resource management and conservation. The Ministry of the Environment and Sustainable Development (MADS) serves as the primary authority, formulating policies and regulations for water and freshwater ecosystems protection. Colombia's legal framework for water management integrates NbS into national strategies through policies such as the National Policy for the Integral Management of Water Resources (PNGIRH), which aligns water governance with land-use planning and ecosystem conservation. Additionally, the National Climate Change Adaptation Plan (PNACC) recognizes NbS as a key strategy for mitigating climate change impacts on water resources. Despite these progressive policies, challenges persist in institutional coordination, enforcement, and financing mechanisms to support widespread NbS implementation.



41 Estudio Nacional del Agua 2022. (2022). IDEAM, Instituto de Hidrología, Meteorología y Estudios Ambientales. https://www.ideam.gov.co/sala-de-prensa/informes/publicacion-jue-23032023-1200.

42 Los ríos en crisis: el ciclo del agua se vuelve impredecible e irregular. (2024, October 8). SCI, Sociedad Colombiana de Ingenieros. https://sci.org.co/los-rios-en-crisis-el-ciclo-del-agua-se-vuelve-impredecible-e-irregular/.

43 Ley 99 de 1993. (1993, December 22). Diario Official. https://www.minambiente.gov.co/wp-content/uploads/2021/08/ley-99-1993.pdf. https://www.minambiente.gov.co/wp-content/uploads/2021/08/ley-99-1993.pdf.

Factsheet Summary	
Main facilitator	Ministry of Housing, Cities and Territories Regulatory Commission for Drinking Water and Basic Sanitation Superintendency of Residential Public Services, Ministry of the Environment and Sustainable Development Regional Autonomous Corporations Water Funds The Nature Conservancy Water and Sanitation Service Providers
Primary Water Objective	Water resources quality, Water resources quantity
Catchment/watershed management or 'End-of-pipe'	Watershed / catchment management, Source water protection
NbS Category	Habitat protection, Habitat restoration, Land management
Co-benefits	Flood management, Biodiversity, Carbon/GHG, Economic benefits
Solution adopted at scale?	Yes, enabled by a regulatory framework that allows water utilities to invest in watershed conservation

The Case Study

The introduction of Resolution CRA 907 in 2019[44] established a regulatory mechanism allowing water utilities to voluntarily allocate service tariff revenues to watershed conservation. This approach enables utilities to invest in land acquisition, aquifer recharge, ecosystem restoration, watershed protection, water monitoring, and payments for environmental services (PES). Water service providers may include in their costs and charge users, in addition to mandatory tariffs and investments, those additional investments they voluntarily decide to make for the protection of their water supply sources, including the management and operational costs associated with these investments.

Relevance to National Context: Colombia's water governance system incorporates multiple stakeholders across sectors and national, regional, and local levels, with regional authorities (CARs) playing a critical role in implementing watershed management plans. The country's legal framework requires states, districts, and municipalities to dedicate at least 1% of their freely disposable income to watershed conservation, creating a foundation for sustainable financing. Furthermore, water and sanitation service providers are obligated to pay a fee for water abstraction and wastewater discharge, both incorporated into the tariff formula,[45,46] and the revenue is transferred to environmental authorities, which allocate it to protection, recovery, decontamination projects, and water resource monitoring.[47] Resolution CRA 907 strengthens this approach by enabling water utilities to directly invest in NbS, aligning economic and environmental objectives to improve water security at scale.

44 Resolución CRA 907 de 2019. (2019, December 23). Diario Oficial. https://normas.cra.gov.co/gestor/docs/resolucion_cra_0907_2019.htm.

45 Ley 99 de 1993. Art 43. Decreto 155 de 2004. Decreto 4742 de 2005. Decreto 1076 de 2015. https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=297.

46 Ley 99 de 1993. Art 42. Decreto 2667 de 2012. Decreto 1076 de 2015. https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=297.

47 Ley 1450 de 2011. Art. 211 y 2016. https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=43101.

Enabling Conditions

Law: Colombia's Constitution recognizes access to water as a fundamental right and mandates state responsibility for water resource protection. The Colombian General Law on the Environment (Law 99/93), along with policies such as PNGIRH and other laws and decrees, provides a legal foundation for integrating NbS into water governance. The National Renewable Natural Resources Code (Decree 2811/07) defines water as a public good and establishes principles for its conservation, use, and management. The regime for public utility services (Law 142/94), to ensure proper management and protection of watersheds and water sources, stipulates that the tariff formulas for aqueduct and sewage services will include elements that guarantee coverage of the costs associated with the protection of water sources, as well as the collection, transportation, and treatment of wastewater.[48] Resolution CRA 907 complements these laws by establishing clear guidelines for water utilities to invest in conservation, outlining the types of eligible expenditures and performance indicators for regulatory oversight. While this framework has been instrumental in promoting NbS, continued refinements in monitoring and impact assessment are needed to ensure optimal effectiveness.

Policy and Regulation: The regulatory approach embedded in Resolution CRA 907 offers a scalable model for integrating NbS into utility-led water resource management. However, its implementation is still in the early stages, with many service providers lacking the technical expertise to design and execute effective conservation projects based on NbS. Strengthening regulatory guidance on best practices, defining standardized methodologies for evaluating impact, and enhancing inter-institutional coordination will be key to maximizing the policy's effectiveness. To be eligible for tariff-based funding, water utilities must make additional environmental investments (IAAs) that meet regulatory requirements. The Superintendency of Public Utilities (SSPD) is responsible for oversight and requires service providers to submit detailed documentation on administrative, operational, and investment costs.

Funding and Finance: In the last decade, water funds have been one of the primary mechanisms for coordination between the public and private sectors for financing programs aimed at ensuring the conservation of water supply watersheds. The ability to recover NbS investment costs through water tariffs provides a long-term financing mechanism, distinguishing Colombia's approach from many other countries where conservation efforts rely on short-term grants. Additional financing sources, including public-private partnerships and international climate funds, further support NbS implementation. However, concerns over affordability and public acceptance of tariff adjustments remain a potential constraint, requiring robust communication strategies to demonstrate the long-term economic and environmental benefits of these investments.

Institutional Arrangements: Colombia's water governance structure is centered around Regional Autonomous Corporations (CARs) overseeing watershed conservation and local governments managing land-use planning. The collaboration between utilities, environmental authorities, and conservation organizations has been critical in advancing the implementation of NbS through the regulatory mechanism. Nonetheless, further institutional strengthening is needed to streamline processes, enhance technical capacity, and ensure alignment between regulatory objectives and local conservation priorities.

Common Execution Conditions: The successful implementation of NbS under Resolution CRA 907 depends on overcoming several operational barriers, including the complexity of land tenure issues, regulatory uncertainty, and the need for long-term monitoring frameworks, through coordination efforts. Partnerships between government agencies, private utilities, and water funds have facilitated knowledge exchange and technical capacity-building. Additionally, the risk of overlapping investments among different agencies underscores the importance of coordination mechanisms to optimize resource allocation. Ensuring that utilities have access to technical guidance and financial incentives would accelerate scaling up NbS projects nationwide. Challenges remain in securing widespread buy-in from service providers, addressing public concerns over tariff increases, and ensuring the long-term financial sustainability of conservation investments.

48 Ley 142 de 1994. Art. 164. https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=2752.

Denmark

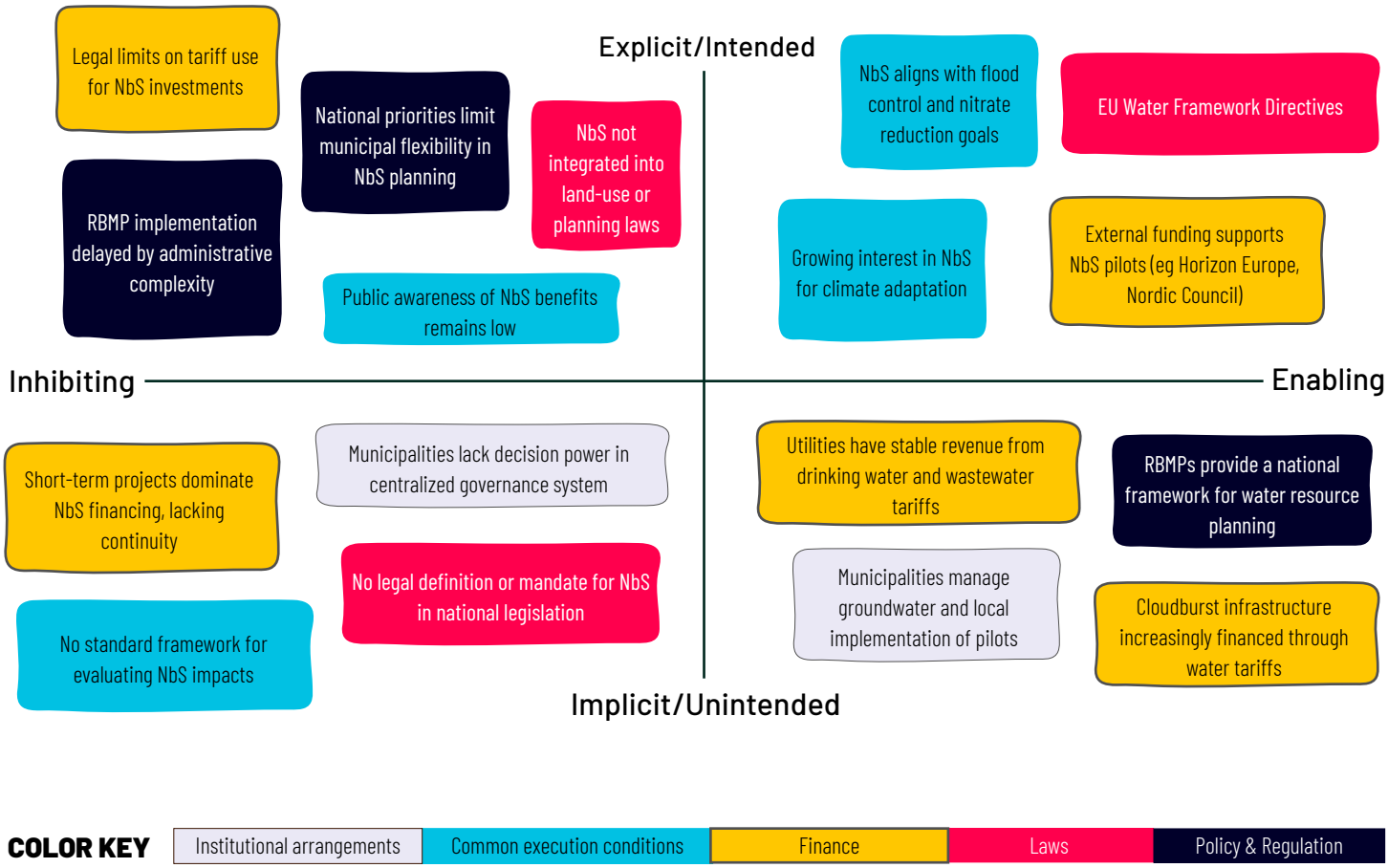
Integrating NbS into Municipal Water Governance

Denmark is integrating nature-based solutions to enhance flood resilience, protect groundwater, and improve water management in urban and rural landscapes.

Context

Water Security: Denmark relies almost entirely on groundwater for its drinking water supply,[49] making it one of the most groundwater-dependent countries globally. This reliance places significant pressure on aquifers, particularly in urban areas such as Copenhagen and Aarhus, where population growth and increased demand have led to concerns about over-abstraction.[50] Additionally, climate change has intensified rainfall variability, contributing to urban flooding and increased runoff pollution. Agricultural activities also present a significant challenge, with nitrate leaching from farmland threatening groundwater quality. The Danish Meteorological Institute has projected an increase in extreme weather events, leading to more frequent floods that further strain urban drainage systems.[51]

Water Resources Management: Denmark's water governance is highly centralized, with national authorities setting policy frameworks that municipalities must implement. Water utilities operate under a break-even principle, ensuring financial self-sufficiency while maintaining high water quality standards. This structure has supported Denmark's leadership in water efficiency, but it has also constrained local innovation in NbS adoption. While various national policies acknowledge the role of NbS, the lack of clear regulatory mandates has slowed large-scale implementation. Additionally, land-use conflicts between urban expansion, agriculture, and conservation areas create further challenges in integrating NbS solutions into national and municipal planning.



49 Jørgensen, L.F., Villholth, K.G., & Refsgaard, J.C. (2017). Groundwater management and protection in Denmark: a review of pre-conditions, advances and challenges. International Journal of Water Resources Development, 33(6), 868-889. https://doi.org/10.1080/07900627.2016.1225569.

50 Henriksen, H.J., Troldborg, L., & Odracek, M. (2024, November 5). Model and Ensemble Indicator-Guided Assessment of Robust, Exploitable Groundwater Resources for Denmark. https://www.mdpi.com/2071-1050/16/22/9861.

51 Vand fra alle sider truer byerne – klimasikring i fællesskab. (2023). HOFOR white paper. https://www.hofor.dk/om-hofor/presse-og-talspersoner/hvidboeger/vand-fra-alle-sider-truer-byerne-klimasikring-i-faellesskab/.

Factsheet Summary	
Main facilitator	Nordic Council of Ministers
Primary Water Objective	Water resources quality, Flood management, Mitigation of agricultural runoff contamination
Catchment/watershed management or 'End-of-pipe'	Watershed/catchment management, Source water protection
NbS Category	Land management
Co-benefits	Flood mitigation, Water quality improvements, Community participation
Solution adopted at scale?	No, but pilot projects and policy integration are expanding

The Case Study

Several Danish municipalities have initiated NbS pilot projects to address specific water security challenges. Aarhus has implemented flood-resilient urban planning that separates rainwater from wastewater to reduce strain on drainage systems. In Copenhagen, cloudburst management strategies integrate NbS, such as green roofs, rain gardens, and permeable surfaces, to mitigate flooding risks.[52] In rural areas, projects focus on nitrate reduction, reforestation, and wetland restoration to improve groundwater quality, demonstrating the viability of NbS in both urban and agricultural settings. These pilot projects have provided valuable lessons in adaptive water management, but challenges remain in mainstreaming these solutions into national infrastructure investment strategies.

Relevance to National Context: Denmark's reliance on groundwater makes water security a critical national priority. The country's approach to water governance aligns with EU directives, particularly the Water Framework Directive, which encourages sustainable water management. While national policies recognize NbS, their implementation has been largely driven by municipalities, often with limited financial and regulatory support. The Nordic Council of Ministers has played a key role in promoting NbS knowledge-sharing across the region, positioning Denmark within a broader Nordic effort to mainstream nature-based approaches. However, the pace of regulatory and institutional adaptation has lagged behind the urgency of climate-related water challenges. Still, new agreements such as the "Informal Green Tripartite Agreement"[53] do indicate progress toward integrated management.

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Enabling Conditions

Laws: Denmark's legal framework contains no clear definitions of NbS within legislation. The Environmental Protection Act[54] regulates groundwater protection, while the Water Supply Act[55] mandates sustainable water use. The EU Water Framework Directive influences national policies, though its application to NbS remains indirect. Strengthening legal mandates for NbS and incorporating them into land-use planning laws could accelerate their integration into water governance.

52 Vand fra alle sider truer byerne - klimasikring i fællesskab. (2023). HOFOR white paper. https://www.hofor.dk/om-hofor/presse-og-talspersoner/hvidboeger/vand-fra-alle-sider-truer-byerne-klimasikring-i-faellesskab/.

53 Mindegaard, A. (2024, November 19). Political Deal reached on Denmark's Green Tripartite – What's in it and what's not? Agricultural and Rural Convention. https://www.arc2020.eu/political-deal-reached-on-denmarks-green-tripartite-whats-in-it-and-whats-not/.

54 Ministry of Environment and Energy. (1999). Act on the promotion of renewable energy (Act No. 384 of 2 June 1999). FAOLEX. https://faolex.fao.org/docs/pdf/den99369.pdf.

55 Water Supply Act (No. 125 of 2017). (2017, February 1). UN Environment Programme. https://leap.unep.org/en/countries/dk/national-legislation/water-supply-act-no-125-2017.

Policy and Regulation: Denmark's policy framework is supportive of water conservation and pollution control. But the country's centralized governance structure means that municipalities have limited discretion in implementing NbS. The River Basin Management Plans (RBMPs)[56] provide a framework for water resource management, but their implementation has been delayed by administrative complexity.[57,58] Denmark's Action Plans for the Aquatic Environment[59,60] have successfully reduced agricultural pollution, demonstrating the potential for regulatory-driven conservation measures. While municipalities are responsible for local action plans, national policies dictate priorities, limiting flexibility.

Funding and Finance: NbS financing in Denmark relies heavily on short-term project funding rather than sustained investment. Water utilities operate on stable financial models through water tariffs levied on the consumer but face restrictions in using tariff revenues for NbS initiatives.[61] Tariffs include drinking water and wastewater services, a green tax, a national water resource tax and VAT. In addition, cloudburst interventions are starting to be financed via the water tariff. External funding from Horizon Europe and the Nordic Council of Ministers supports pilot projects but lacks long-term continuity. Developing financial instruments such as green bonds or NbS-targeted water tariffs could enhance funding stability. Additionally, integrating NbS into municipal budgets and ensuring they are included in long-term climate adaptation plans would provide a more structured financial pathway for scaling up these initiatives.

Institutional Arrangements: Denmark is part of the Nordic Council and Nordic Council of Ministers, a formal inter-parliamentary co-operation with the goal of harmonizing and forming common visions between its members. The Nordic Council has published several reports on NbS and pilot studies.[62] Within Denmark, water governance has strong national control with Ministry of the Environment overseeing policy and municipalities responsible for local implementation. Municipalities play a central role in groundwater protection but face regulatory constraints in adopting NbS. Strengthening inter-agency collaboration and creating formal mechanisms for multi-stakeholder engagement could improve NbS governance and scalability. Furthermore, building technical expertise among municipal planners, engineers, and policymakers would facilitate more effective NbS design and implementation.

Common Execution Conditions: Barriers to NbS implementation in Denmark include limited local authority decision-making and insufficient funding. While pilot projects have demonstrated NbS effectiveness, the absence of standardized evaluation frameworks hinders broader adoption. Public awareness of NbS remains relatively low, requiring targeted communication efforts to build support. Addressing these challenges will require clearer regulatory frameworks, expanded financing options, and enhanced institutional capacity for NbS planning and execution. Strengthening knowledge-sharing platforms and integrating NbS principles into higher education curricula for environmental planning and engineering could further support long-term adoption.

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56 Water Supply Act (No. 125 of 2017). (2017, February 1). UN Environment Programme. https://leap.unep.org/en/countries/dk/national-legislation/water-supply-act-no-125-2017.

57 Nielsen, H. Ø., Frederiksen, P., Saarikoshki, H., Rytkönen, A., & Pedersen, A.B. (2013). How different institutional arrangements promote integrated river basin management. Evidence from the Baltic Sea Region. Land Use Policy, 30, 437-445. http://dx.doi.org/10.1016/j.landusepol.2012.04.011.

58 Olsen, B. E., & Tegner Anker, H. (2016). Nordic countries: A. Denmark. Yearbook of International Environmental Law, 25(1, 1 January 2014), 347-352.

59 Hölscher, L., & Gehre, L. (2018, September 3). Denmark: Action plans for the aquatic environment and green growth agreement. Adelphi. https://www.euki.de/wp-content/uploads/2018/09/fact-sheet-actions-plans-dk.pdf.

60 Petersen, R.J., Blicher-Mathiesen, G., Rolighed, J., Andersen, H.E., & Kronvang, B. (2021, September 15). Three decades of regulation of agricultural nitrogen losses: Experiences from the Danish Agricultural Monitoring Program. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0048969721026905.

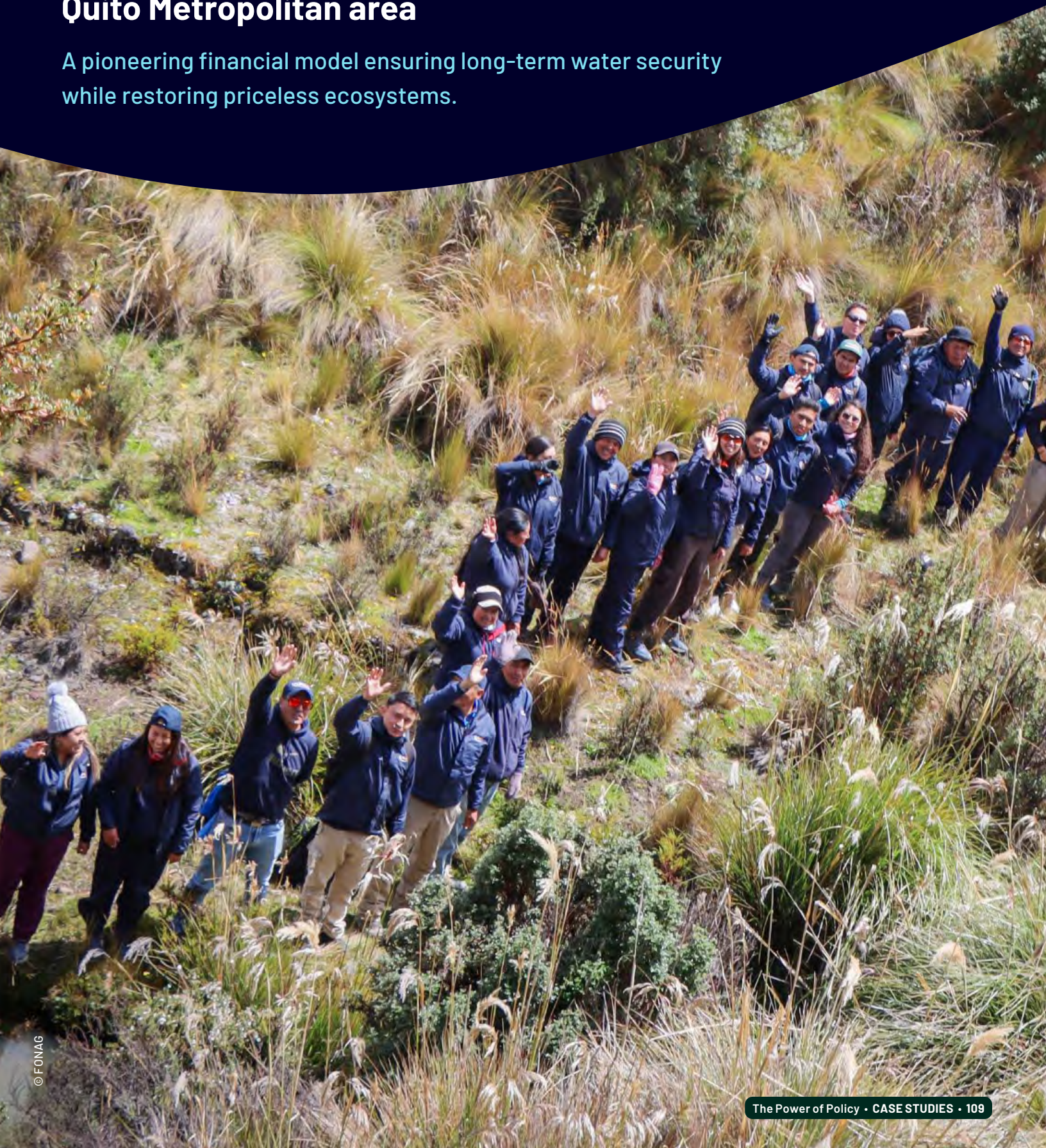
61 Larsen, C-E. (2022) Water in figures: 2022 Denmark. DANVA, IWA World Water Congress & Exhibition 2022. https://www.danva.dk/media/8746/5307102_water-in-figures-2022_web.pdf.

62 According to the Aqueduct Water Risk Atlas. (2025). https://www.wri.org/applications/aqueduct/water-risk-atlas/#/?advanced=false&basemap=hydro&indicator=w_awr_def_tot_cat&lat=30&lng=-80&mapMode=view&month=1&opacity=0.5&ponderation=DEF&predefined=false&projection=absolute&scenario=optimistic&scope=baseline&.

Ecuador

FONAG, Water Protection Fund of the Quito Metropolitan area

A pioneering financial model ensuring long-term water security while restoring priceless ecosystems.

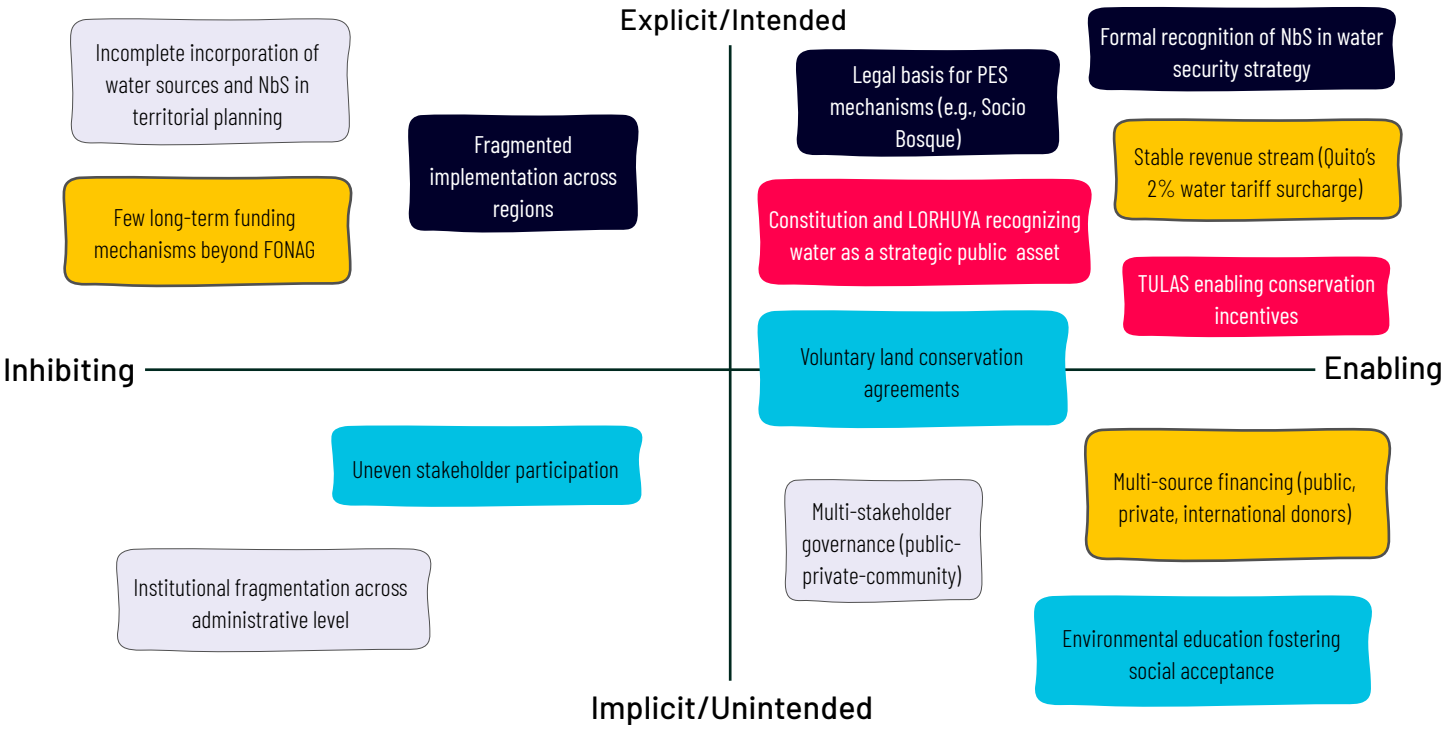


© FONAG

Context

Water Security: Ecuador is categorized as "insecure" in global assessments,[63] with major watersheds—particularly those supplying cities like Quito—struggling with degradation, pollution, and unsustainable extraction. The Andean highlands, where the páramos[64] play a critical role in regulating water flow, have suffered from deforestation and encroaching agricultural activities. Quito, Ecuador's capital, relies on a combination of surface water sources and a small proportion of groundwater.[65] But increasing demand, combined with aquifer deterioration, has made long-term water management a pressing issue.

Water Resources Management: The 2008 Constitution[66] and the Organic Law on Water Resources (LORHUYA)[67] enshrine water as a strategic national asset and mandates state-led, ecosystem-based water management. The Ministry of Environment, Water, and Ecological Transition (MAATE) is the lead authority, coordinating water governance. Water services are managed by public and community entities. The Municipal Decentralized Autonomous Governments must comprehensively manage drinking water and sanitation within their jurisdictions, coordinating with regional and provincial governments for the maintenance of watersheds that supply water for human consumption.[68] However, while these regulations establish a foundation for conservation, implementation remains fragmented, and funding mechanisms for long-term environmental stewardship are often insufficient.



63 MacAlister, C., Baggio, G., Perera, D., Qadir, M., Taing, L., & Smakhtin, V. (2023). Global Water Security 2023 Assessment. United Nations University, Institute for Water, Environment and Health. https://unu.edu/inweh/collection/global-water-security-2023-assessment.

64 For more details on the Paramos and their role for water resources protection see this artice: Lessons from the Páramos: How Watershed Conservation Is Restoring Biodiversity. (2025, February 24). https://www.nature.org/en-us/what-we-do/our-insights/perspectives/watershed-conservation-restoring-biodiversity/.

65 El agua en la economía verde: Hacia Rio +20. (n.d.). https://www.eoi.es/blogs/embacon/2012/01/16/el-agua-en-la-economia-verde-hacia-rio20/ Escuela de Organización Industrial.

66 Constitution of Ecuador in Spanish: https://www.gob.ec/sites/default/files/regulations/2018-11/constitucion_de_bolsillo.pdf. Unofficial version in English: https://pdba.georgetown.edu/Constitutions/Ecuador/english08.html.

67 Organic Law of Water Resources Water Uses and Development. (2014, August 6). Ecojurisprudence.org. https://ecojurisprudence.org/wp-content/uploads/2023/07/Ecuador-Ley-Organica-de-Recursos-Hidricos-Usos-y-Aprovechamiento-del-Agua_English-translation.pdf.

68 According to Art. 137, Organic Code of Territorial Organization of Ecuador (COOTAD). 2010. Quito, Ecuador.

Factsheet Summary	
Main facilitator	FONAG EPMAPS–Metropolitan Water Supply and Sanitation Public Company of Quito The Nature Conservancy
Primary Water Objective	Water resource quantity
Catchment/watershed management or 'End-of-pipe'	Catchment management, Water resource management
NbS Category	Land management
Co-benefits	Biodiversity, Carbon sequestration, Economic benefits, Social benefits
Solution adopted at scale?	No, even though the area of the country includes the capital city and 10.4 % of the country's population

The Case Study

In response to these challenges, the Water Protection Fund FONAG was created in 2000 and designed to provide continuous, dedicated funding for the conservation of water resources. Structured as a financial trust, FONAG pools contributions from EPMAPS, private companies, and international donors to finance conservation and restoration efforts in Quito's key water supply areas. The fund prioritizes watershed protection through land management agreements, restoration, and environmental education, ensuring the long-term sustainability of the city's water supply. It also owns and manages environmentally sensible lands and supports the management of other protected areas, all important as water catchments.


© FONAG

Relevance to National Context: FONAG remains a unique case in Ecuador, standing as the only water fund with a stable and continuous financing model. Despite its longevity and recognized success, no equivalent initiative has been developed elsewhere in the country at a comparable scale. While Ecuador's legal and institutional landscape supports conservation finance and recognizes the role of natural infrastructure in water security, replication of FONAG's model remains incomplete. The other existing water funds created later in the country could not achieve financial sustainability yet.

Enabling Conditions

Law: National legislation mandates the protection of ecosystems that sustain water supply. In addition to the constitution and the LORHUYA, the unified text of secondary environmental legislation (TULAS)[69] has allowed the development of payment for Ecosystem Services (PES) mechanisms, such as the Socio Bosque program, to provide financial incentives for conservation. However, while legislation formally integrates NbS into national water management, implementation gaps persist, enforcement mechanisms are weak, and financial models ensuring long-term sustainability remain scarce outside of FONAG.

Policy and Regulation: Policy and regulatory frameworks in Ecuador provide a foundation for NbS but lack comprehensive mechanisms for implementation and enforcement. Despite legal provisions recognizing the importance of ecosystem conservation in water security, there is limited integration of NbS within national water management planning and decision-making processes. FONAG's experience underscores

69 According to Art. 137, Organic Code of Territorial Organization of Ecuador (COOTAD). 2010. Quito, Ecuador.

the need for clearer institutional mandates and stronger regulatory enforcement to ensure long-term conservation commitments. While this institution benefits from a stable funding model, other regions face regulatory and financial barriers to establishing similar mechanisms. Strengthening legal incentives for conservation, improving regulatory oversight, and aligning water governance structures with NbS principles will be essential for broader adoption and scaling of sustainable water management strategies across Ecuador.

Finance and Funding: Financial stability is secured through a 2% surcharge on Quito's water tariff.[70] Despite successes facilitated by its sustainable financing approach, FONAG faces several barriers. The fund's unique private trust arrangement and continuous revenue from Quito's water tariff provide stability that contrasts sharply with broader financial and legal frameworks in Ecuador, which often centralize fiduciary oversight under state institutions. This contrast highlights regulatory challenges faced by other water funds attempting to replicate FONAG's efficiency. Regulatory reforms allowing more adaptive financial models, supported by demonstrated economic returns ($1.31 per dollar invested),[71] are necessary to scale successful NbS financing across Ecuador.

Institutional Arrangements: Institutional collaboration has played a key role in FONAG's resilience. FONAG operates as a multi-stakeholder entity, bringing together public and private actors, local communities, and international partners. This governance model enhances technical expertise, knowledge-sharing, and capacity-building, ensuring that conservation efforts align with scientific research and best practices. Economic analyses demonstrating the financial viability of FONAG's interventions have further strengthened institutional commitment, bolstering support from decision-makers and stakeholders. Additionally, long-term monitoring programs funded by the revenue stream have provided valuable data, informing adaptive management strategies and reinforcing stakeholder support through clear economic evidence. However, there are challenges in territorial zoning regulations where a piece of land is defined as urban or agricultural, but its role as a water source is not reflected. The integration of a conservation-focused approach for water sources into territorial zoning frameworks remains incomplete, posing a significant barrier to their protection and sustainable management.

Common Execution Conditions: Public engagement and social acceptance are essential components supported by FONAG's sustainable funding model. Environmental education programs, financed through stable revenue streams, have increased community awareness about the páramos' role in water provision, fostering local support for conservation initiatives. Landowners and communities participate in voluntary conservation agreements, receiving financial and technical assistance backed by FONAG's consistent funding. Although challenges remain in ensuring equitable benefits and strengthening participation, evidence of financial viability and institutional backing has generally secured positive reception and facilitated ongoing policy support.

70 According to article II.383.7 "Contribution for the Protection of Water Sources" of the Environmental Ordinance in the Municipal Code for the Metropolitan District of Quito. 2007. https://www.registroficial.gob.ec/.

71 Retorno sobre la inversión en soluciones basadas en la naturaleza para el agua. (2023). ATUK. https://atuk.com.ec/documentos/atuk-sbm-roi.pdf.

England and Wales

Catchment Nutrient Balancing in Poole Harbour

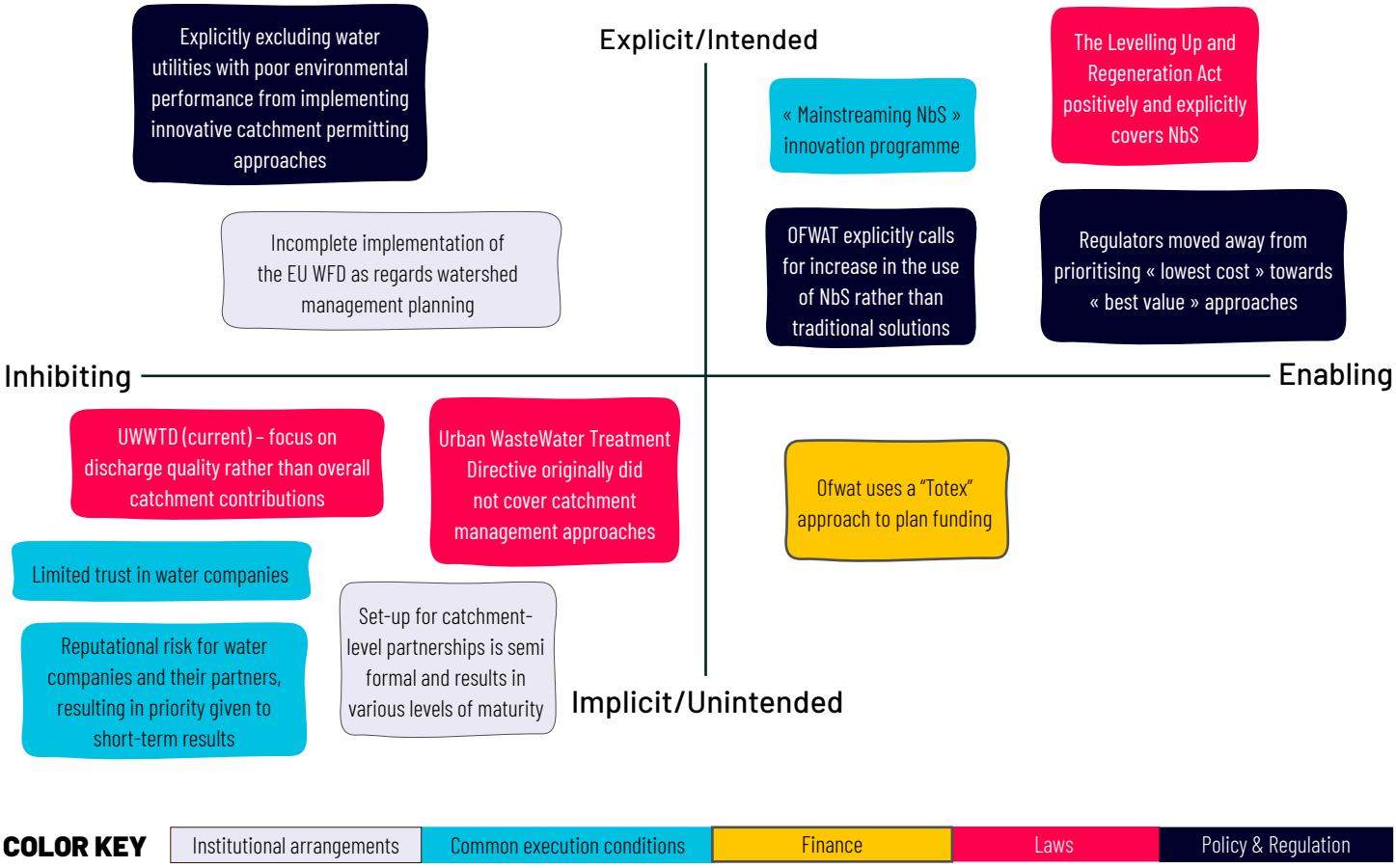
A successful approach still waiting to scale.

© Wessex Water

Context

Water Security: The UK has high levels of water security and has benefitted from improvements over the last 35 years in terms of the quality of drinking water and wastewater treatment. However, climate change, population growth, and tightening environmental standards are putting water services under increasing pressures. Evidence gathered by regulators demonstrates that multiple sectors impact water security and river health. The relative impact varies by watershed, but at a national scale, the activities of water utilities, agriculture, and runoff from urban areas dominate. Management of these sectors and individual actors within them is generally siloed, which can undermine the ability to meet overall water security objectives or lead to sub-optimal solutions. In this context, nutrient pollution is a significant challenge.

Water and Wastewater Management: The UK water sector, in England and Wales,[72] operates under a regulatory framework that aims to balance private ownership of water and wastewater utilities with public oversight. The UK government sets overall policy through the Department for Environment, Food & Rural Affairs (DEFRA). Water and wastewater services are provided by regional private companies. Ofwat, the economic regulator, sets revenue allowances for companies to maintain and improve service quality, invest in infrastructure, and secure finance. The Environment Agency (EA) oversees environmental standards, focusing on water quality and pollution control. The Drinking Water Inspectorate (DWI) ensures the safety of drinking water, and the Consumer Council for Water is the representative body for customers.



72 The ownership model is different in Scotland. The case study presented here is in England.

Factsheet Summary	
Main facilitator	Wessex Water Environment Agency Ofwat Local Farmers
Primary Water Objective	Water quality
Catchment/watershed management or 'End-of-pipe'	Catchment management
NbS Category	Land management
Co-benefits	Biodiversity, Carbon reduction, Soil health and economic benefits for farmers
Solution adopted at scale?	Yet to achieve scale on a national level, and catchment management approaches in general remain limited

The Case Study

Poole Harbour is Europe's largest natural harbor and a Protected Area that is impacted by nitrogen pollution. Nitrogen concentrations cause twin public health and environmental issues: elevated nitrates in groundwater can compromise water resources with respect to drinking water (DWI) standards; and cause eutrophication in surface waters impacting the ecological balance within the Harbour. Wessex Water initiated a farmer advice and support programme in 2009 to reduce nitrate leaching around groundwater sources improving fertilizer efficiency, reducing wastage and protecting drinking water abstractions from non-compliance.

© Wessex Water

Population growth in the catchment was identified as a further risk to surface water quality, and in 2016, Wessex Water set up a Payment for Ecosystem Services scheme to facilitate farmer participation in nitrogen reduction efforts as an alternative to investment in enhanced wastewater treatment. Farmers were incentivized to alter agricultural practices, such as planting cover crops, to decrease nitrogen runoff into the harbor (an approach termed "Catchment Nutrient Balancing"). The EA and Ofwat supported this approach, and Wessex Water was able to exceed its nitrogen reduction targets at approximately 70% lower cost compared to the alternative conventional grey infrastructure approach, while also providing additional environmental benefits such as habitat creation and carbon sequestration. The scheme continues to operate and has evolved substantially in terms of the farming practices supported. An additional benefit was that, to operate the scheme, Wessex Water created a market platform and set this up outside of the regulated business as a separate business unit trading as "EnTrade." EnTrade[73] has innovated in nature market design in collaboration with academic institutions, regulators, local authorities, policy-makers, and NGOs. It is now established as an independent company, EnTrade Ltd., backed in joint venture between YTL UK and Arup, as a Market Operator of high integrity nature markets, which it is aiming to roll out across the UK.

Relevance to National Context: Nutrient markets have yet to achieve scale on a national level, and catchment management approaches in general remain limited. Nutrient pollution challenges exist across England and Wales. The need to enable multiple sectors to effectively collaborate on the issues, and to adopt NbS, remains highly acute.

73 About Us. (2025). Entrade. https://www.entrade.co.uk/about-us.

Enabling Conditions

Law: The UK water sector operates under multiple pieces of legislation, including the Water Industry Act (1991), the Environment Act (2021),[74] the Levelling Up and Regeneration Act (2023)[75] and transposed EU directives notably the Water Framework Directive (WFD) and the first Urban WasteWater Treatment Directive (UWWTD) and Drinking Water Directive. Very significant water quality improvements have been achieved with these as the drivers. However, in the context of water utilities adopting NbS, they can pose significant, if unintended, barriers. This manifests itself most clearly in terms of catchment management approaches, which by their nature do not impact the discharge quality of treated wastewater and therefore are not covered by the original UWWTD. This is in contrast to the WFD, which is concerned with the water body impacted rather than purely the water company operations (and which enabled the several NbS projects around the UK). Poole Harbour offsetting was initially enabled via a Consent Order related to Habitat and Species Regulation (2017),[76] with further delivery via a bespoke Asset Management Plan 7 performance commitment. The Levelling Up and Regeneration Act positively and explicitly covers NbS in stating that "a sewerage undertaker [wastewater company] must consider whether NbS, technologies and facilities relating to sewerage and water could be used to meet the standard." However, this legislation also sets requirements for wastewater treatment works in certain sensitive areas to operate at the Technically Achievable Limit, which is seen by stakeholders as driving grey infrastructure solutions. It also must be enacted via secondary legislation or emergency approval, which has yet to be enacted.

Policy and Regulation: Ofwat set out its position on catchment NbS "From catchment to customer in 2011, and supported the Poole Harbour scheme and others by enabling the funding. Ofwat has relatively recently become more explicit in calling for water companies to consider and implement NbS. In the most recent 5-yearly Price Review[77] a step change increase in the use of nature-based rather than traditional solutions." The Environment Agency has relatively recently also become explicit in calling for "a clear commitment to pursue C&NBS[78] wherever they can deliver all or part of the required environmental outcome"[79] and has provided tools such as "environmental outcome metrics" to support this. Similarly, for PR24 the government[80] strategic policy guidance that "Water companies are expected to adopt NbS as much as possible." Other than encouragement, the primary way in which regulators are trying to facilitate the adoption of NbS is to move away from explicitly prioritizing lowest cost solutions toward the incorporation of Natural Capital Accounting measures or "Best Value"[81] which incorporate wider outcomes and benefits (such as carbon, biodiversity, amenity) while still applying affordability considerations. Despite these developments, many consider the adoption of catchment and NbS has yet to reach its full potential, and that other aspects of policy and regulation (such as inflexible permitting) hinder adoption at scale. Ofwat has funded an innovation program called "Mainstreaming NbS"[82,83] to help address this.

Funding and Finance: The longstanding UK model is that water utility investment and operations get funded entirely through customer bills (including the Poole Harbour scheme). Financing is attracted by individual water companies through a mixture of debt and equity finance. In some projects, water companies have blended customer money with agri-environment grant support from government, for example, by providing capital investment that enables farmers to adopt farming practices that grant schemes can then support. Farmers must already be complying with minimum standards and other regulatory requirement before receiving further support from utilities; utilities can only invest in NbS beyond compliance, not to meet it. The extent to which water companies can contribute is also affected by polluter pays and fair share principles.[84] There is fundamentally no difference in how Ofwat treats water company expenditure for NbS versus

74 Environment Act 2021. (2021). The Stationery Office. https://www.legislation.gov.uk/ukpga/2021/30/pdfs/ukpga_20210030_en.pdf.

75 Levelling-up and Regeneration Act 2023. (2023). The Stationery Office. https://www.legislation.gov.uk/ukpga/2023/55/pdfs/ukpga_20230055_en.pdf.

76 The Conservation of Habitats and Species Regulations 2017, SI 2017/1012. (2017). Legislation.gov.uk. https://www.legislation.gov.uk/uksi/2017/1012/contents.

77 Price reviews. (2025). Ofwat. https://www.ofwat.gov.uk/regulated-companies/price-review/.

78 C&NBS stands for "Catchment and Nature-based Solutions."

79 Water industry national environment programme (WINEP) methodology. (2022, May 11). GOV.UK. https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-national-environment-programme-winep-methodology. There should be a clear,and improvements to ecosystem services.

80 Water industry strategic environmental requirements (WISER): technical document. (2022, May 11). GOV.UK. https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-strategic-environmental-requirements-wiser-technical-document.

81 Water industry national environment programme (WINEP) methodology. (2022, May 11). GOV.UK. https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-national-environment-programme-winep-methodology#:~:text=The%204%20wider%20environmental%20outcomes,and%20access%2C%20amenity%20and%20engagement.

82 Mainstreaming nature-based solutions to deliver greater value. (2025). Ofwat Innovation Fund. https://waterinnovation.challenges.org/winners/mainstreaming-nature-based-solutions/.

83 Mainstreaming nature-based solutions to deliver greater value. (2025). Ofwat Innovation Fund. https://waterinnovation.challenges.org/winners/mainstreaming-nature-based-solutions/.

84 PR19 Fair Share principles paper: Outlining the key aspects of the approach. (2017, January 30). Environment Agency. https://www.contractsfinder.service.gov.uk/Notice/Attachment/64b509d5-f0f8-45d8-8c7c-7615d66afbe4.

grey infrastructure. However, there are considered to have been implicit, unintended disincentives against NbS within the original approach to costs. Ofwat's move from a Capital expenditure (Capex) and Operational expenditure (Opex) approach to a Total expenditure (Totex) approach, to mitigate against what was perceived to be a "capex bias," created more equal opportunity for NbS. Further adjustments have recently been made specifically for NbS related to the treatment of operating expenditure. Ongoing Opex is considered more difficult to secure than upfront Capex, and Ofwat evolved its approach for PR24 with an aim to address this.[85]

Institutional Arrangements: Many actors across the water sector still tend to work largely within their own spheres of influence, managing their own priorities in relative isolation from others. Implementation of the Water Framework Directive has led to the production of River Basin Management Plans, but the regime has been criticized by the statutory Office for Environmental Protection because it "… lacks robust delivery and governance mechanisms to create accountability and achieve outcomes."[86] Smaller-scale semi-formal catchment partnerships have been in existence for a number of years under a voluntary Catchment Based Approach (CaBA) framework, "an inclusive, civil society-led initiative that works in partnership with Government, Local Authorities, Water Companies, businesses and more, to maximize the natural value of our environment."[87] These partnerships have formed to a greater or lesser degree of maturity in different locations. More mature partnerships including Local Authorities, such as in the Bristol Avon[88] or the River Severn,[89] enable the greater integration of the critical land-use component to managing the water environment. Further models of collaboration are emerging, such as through the Norfolk Water Strategy Programme[90] or the Greater Manchester Integrated Water Management Plan,[91] but none plays a formal role in statutory planning processes.

Common Execution Conditions: Several factors have led to a significant and rapid decline in trust in the water sector, which needs to be rebuilt. Water companies tend to be perceived as the primary or only cause of all the issues with rivers and seas, even if the picture is far more complex and nuanced. This has led to policies and behaviors that can be unhelpful for the adoption of NbS. It can lead to water companies needing to prioritize speed of response and quick wins over solutions that are more beneficial over the long term. Public pressure and media blame has also created reputational risk for third parties working with water companies—undermining the willingness or ability to be able to collaborate effectively together, which is vital in deploying NbS. Pressure on government and regulators to be tough on utilities heightens the sense of risk of failure and caution around the use of NbS.

85 Creating Tomorrow, Together: Our final methodology for PR24, Appendix 9. (2022, December). Ofwat. https://www.ofwat.gov.uk/wpcontent/uploads/2022/12/PR24_final_methodology_Appendix_9_Setting_Expenditure_Allowances.pdf.

86 A review of implementation of the Water Framework Directive Regulations and River Basin Management Planning in England. (2024, May). Office for Environmental Protection. https://www.theoep.org.uk/sites/default/files/reports-files/A%20review%20of%20the%20implementation%20of%20River%20Basin%20Management%20Planning%20in%20England_Accessible.pdf.

87 Working together to improve the water environment. (n.d.). Catchment Based Approach. https://catchmentbasedapproach.org.

88 About us. (2025). Briston Avon Catchment Partnership. https://www.bristolavoncatchment.co.uk/about-us/.

89 Welcome. (n.d.). River Severn Partnership. https://www.riversevernpartnership.org.uk/.

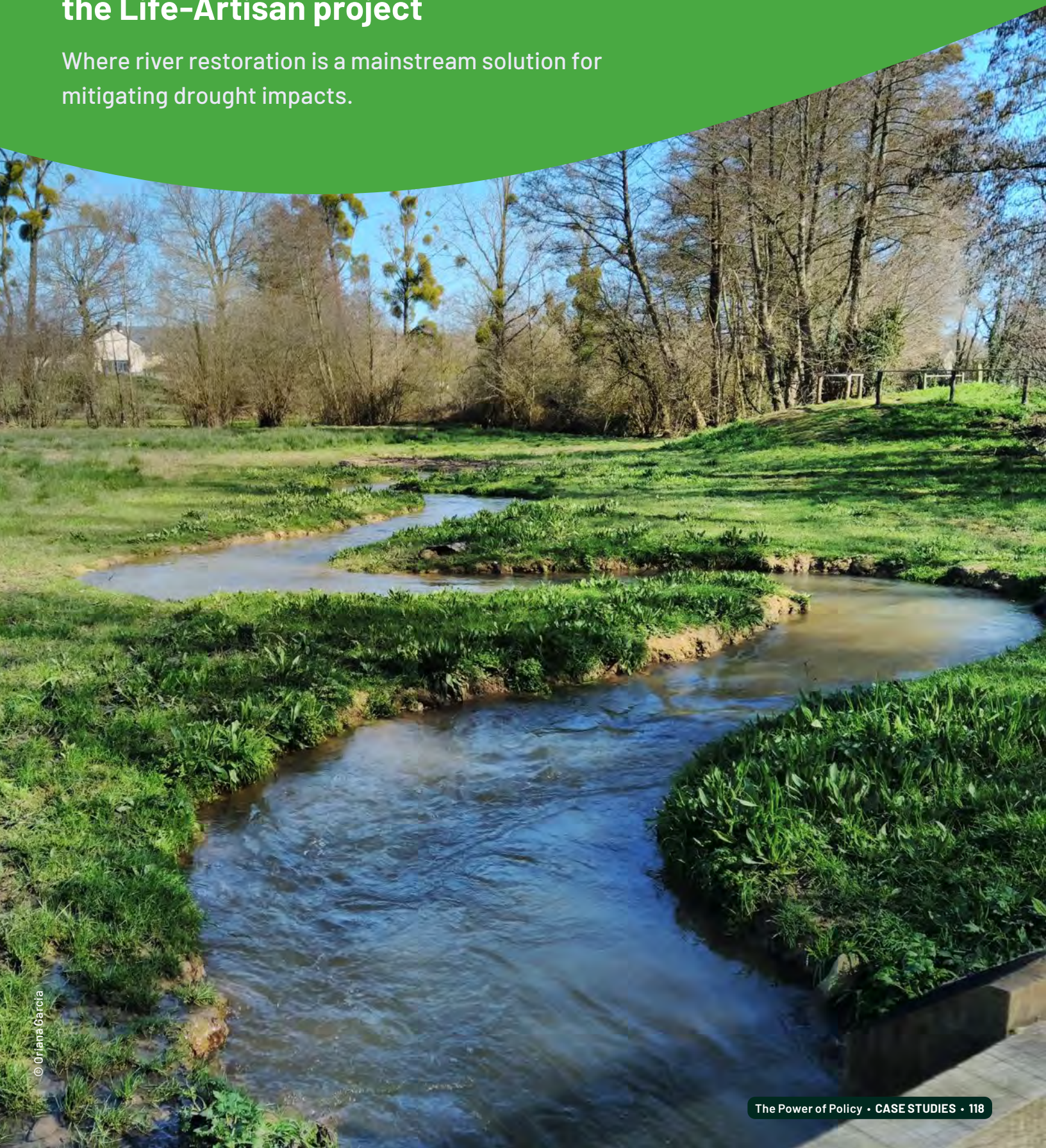
90 Norfolk Water Strategy Programme. (n.d.). Water Resources East. https://wre.org.uk/projects/norfolk-water-strategy-programme/.

91 Integrated Water Management Plan. (2025). Greater Manchester Combined Authority. https://www.greatermanchester-ca.gov.uk/what-we-do/planning-and-housing/strategic-planning/integrated-water-management-plan/.

France

Néal River watershed as part of the Life-Artisan project

Where river restoration is a mainstream solution for mitigating drought impacts.



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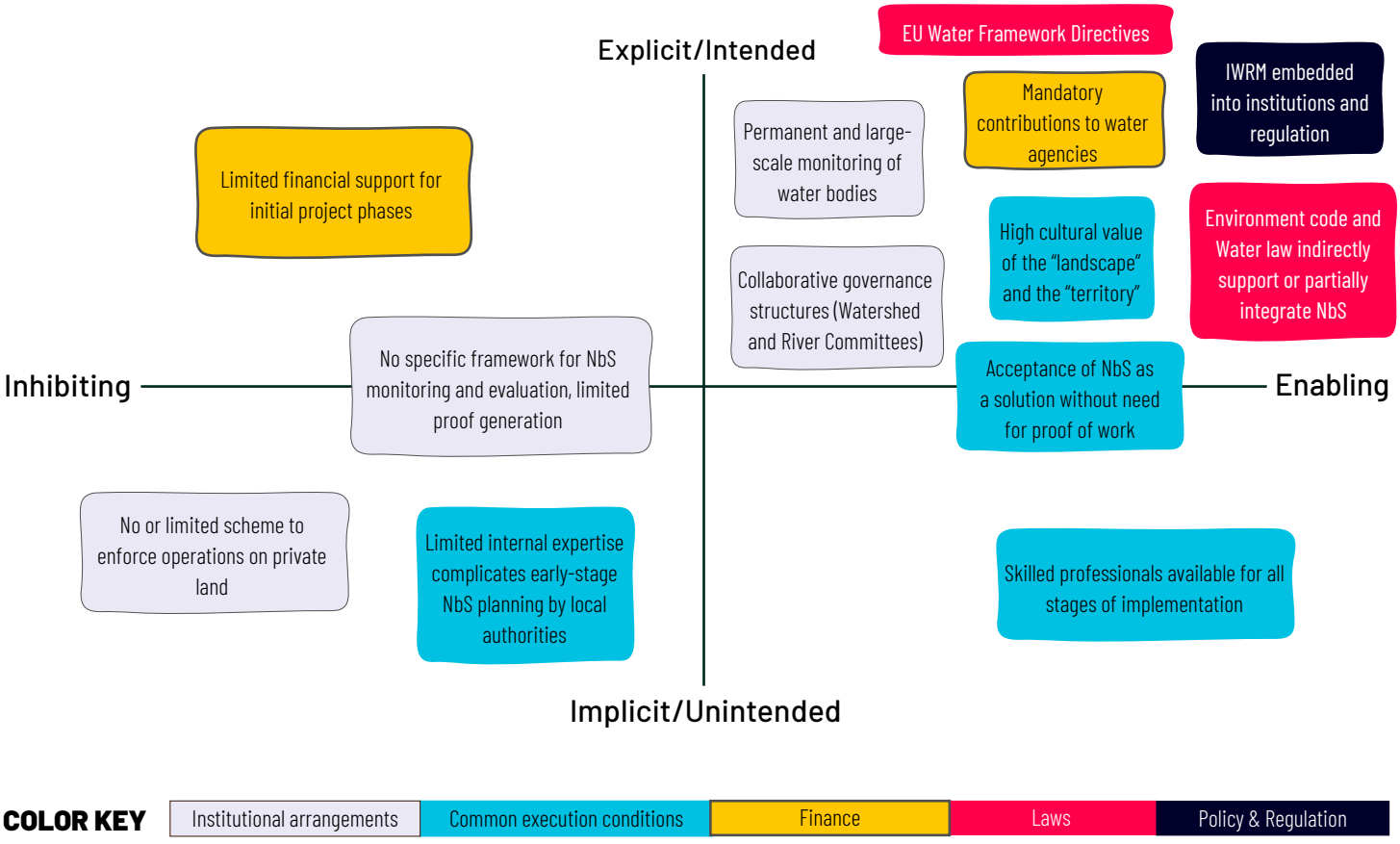
Context

Water Security: Though France is one of the water-secure countries in the world,[92] recent droughts have revealed vulnerabilities. During the drought of summer 2023, 75% of the French population was affected by local decrees limiting the use of drinking water (ban on filling swimming pools, washing cars, watering lawns, etc.). But the most important impact was experienced by the agricultural sector, with significant declines in production, particularly in cereals (estimated 30%). This sparked public debate on resource allocation and elevated the climate resilience of water resources as a political priority.

Water Resources Management: France's water resources management operates within a multi-tiered governance system that integrates national oversight with regional and local implementation. At the national level, the Ministry for Ecological Transition establishes policies and strategic frameworks, ensuring compliance with European Union directives and international agreements. Regionally, six autonomous Water Agencies manage resources within major watersheds. These agencies, funded by user fees and pollution charges, coordinate water management efforts, allocate financial resources, and monitor water quality and quantity. The water resources planning is coordinated at the level of each of the six watersheds through the completion of a master plan (SDAGE: "Schéma Directeur d'Aménagement et de Gestion des Eaux"), which designates priority areas for the preservation of water resources and wetlands as part of the resources management. The implementation of this master planning at a local level is guided by watershed and river committees, which include representatives from local governments, civil society, industry, and agriculture to ensure stakeholder participation in decision-making.



92 Ranked 11th in Europe and 12th worldwide, according to MacAlister, C., Baggio, G., Perera, D., Qadir, M., Taing, L., & Smakhtin, V. (2023). Global Water Security 2023 Assessment. United Nations University, Institute for Water, Environment and Health. https://collections.unu.edu/eserv/UNU:9107/n23-116_UNU_Water_Security_WEB_Final_updated.pdf.

Factsheet Summary	
Main facilitator	Forum des Marais Atlantiques French Biodiversity Agency Local Authority–Communauté de Communes de Saint Méen-Montauban
Primary Water Objective	Water resource quantity
Catchment/watershed management or 'End-of-pipe'	Catchment management, Water resource management
NbS Category	Land management
Co-benefits	Biodiversity
Solution adopted at scale?	Yes

The Case Study

The Néal watershed project focuses on securing environmental water flow and resilient supplies for the Rophémel reservoir, which serves approximately 470,000 residents in the urban area around Rennes, Brittany. To achieve this, activities target the Néal River watershed, where the aquifer's low storage capacity and increasing drought conditions pose a high risk of water scarcity and reduced flow for the downstream reservoir. Key initiatives include the protection and restoration of river streams that have degraded into ditches over time, as well as promoting voluntary water consumption reductions among farmers through best practices. The project is implemented by local authorities ("Communauté de Communes de Saint Méen-Montauban") under a watershed contract ("Contrat de bassin"), a framework specifically designed for water resource management.

Relevance to National Context: This approach is not unique in France. The Néal watershed was selected as a case study because it has been extensively monitored and informed by researchers as part of the Life-Artisan project, making information and takeaways more accessible. This project is a European Commission-funded initiative (60%) managed by the French Office for Biodiversity (OFB), aiming at demonstrating and enhancing the potential of NbS through research, advocacy, and pilot activities. It contributes to the second National Climate Change Adaptation Plan and France's Biodiversity Plan.[93]

Enabling Conditions

Law: The move toward NbS could be dated back to the creation of the Ministry of protection of nature and the environment in 1971, which resulted in a progressive integration of ecological principles in various layers of legislation. The Environmental Code,[94] and within it the Water Law,[95] indirectly support or partially integrate NbS in various ways. The preservation of habitats and wetlands is one of the main obligations formulated in land-use planning legislation. These provisions are integrated into land masterplans further than simply considering protected areas, as they require all existing wetlands to be considered, even when their impact on biodiversity or resource management is not obvious. In addition, the 2010 Grenelle II law[96] mandates environmental flow requirements and protects all water bodies, emphasizing a comprehensive approach to sustainable water management.

93 Stratégie nationale biodiversité 2030. (2023). Biodiversité.gouv.fr. https://biodiversite.gouv.fr.

94 Code de l'Environnement. (2025). Légifrance. https://www.legifrance.gouv.fr/codes/texte_lc/LEGITEXT000006074220.

95 Loi n° 92-3 du 3 janvier 1992 sur l'eau. (2006). Légifrance. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000173995. Loi n° 2006-1772 du 30 décembre 2006 sur l'eau et les milieux aquatiques (2008). Légifrance. https://www.legifrance.gouv.fr/dossierlegislatif/JORFDOLE000017758328/ also has important provisions on water resources management.

96 LOI n° 2010-788 du 12 juillet 2010 portant engagement national pour l'environnement (1). (2021). Légifrance. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000022470434.

Policy and Regulation: The stakeholder framework separates water services (implemented by utilities) and water resource protection (managed by local authorities with government support). Collaborative governance is promoted through watershed and river contracts ("Contrats de bassin" and "Contrats de rivière"), which bring together local governments, public authorities, water syndicates, agricultural chambers, and civil society organizations. These agreements foster shared responsibility for water conservation, though they do not involve any formal transfer of authority among signatories. From a planning perspective, adopting a watershed-wide approach and explicitly incorporating the maintenance or rehabilitation of wetlands as a key objective inherently leads to a greater emphasis on NbS. In the case of the Néal River, while the SDAGE Loire-Bretagne makes only brief reference to NbS, it strongly prioritizes the preservation and restoration of wetlands.[97]

Funding and Finance: Financing water security in France follows the "water pays for water" principle, with most costs covered by user fees. Water Agencies are financed through mandatory contributions from all water users, including water tariffs, fees for industrial and agricultural water abstraction, and pollution charges. This system generates approximately €2.2 billion annually, available to water security projects through subsidies. However, initial project planning and coordination rely on voluntary efforts by local authorities, funded from their own budgets. While they receive technical oversight from government authorities, they lack financial support. In the Néal case, this early phase was bolstered by support from the Life-Artisan Project, which is an exception.

Institutional Arrangements: Locally, municipalities are responsible for providing water supply and sanitation services, either directly or through delegated private utilities, and most frequently by clustering. They also implement resource protection measures, often collaborating with other stakeholders through watershed or river contracts. These agreements facilitate coordinated action among municipalities, water syndicates, chambers of agriculture, and community organizations without transferring formal authority. The watershed-level planning approach is a significant driver for NbS adoption. However, operations on private land require landowner consent, and no penalties exist for non-participation. Local authorities must navigate this challenge while balancing other pressures, such as the economic importance of agriculture, often without sufficient technical capacity or resources. In doing so, they receive support and oversight from government representations at regional local level.

Common Execution Conditions: Public engagement in watershed-level planning is limited but grows during project implementation, supported by cultural values emphasizing a connection to the land. This cultural alignment fosters community support, encouraging residents and farmers to adopt sustainable practices and participate in NbS projects as part of a broader environmental ethic. With environmental protection widely regarded as deserving extra effort, NbS projects are generally accepted as being positive, reducing the need to demonstrate efficacy in advance. This contrasts with the highly developed system for monitoring water resource quantity and quality, which informs planning and investment decisions in France. Thus, while there is strong demand for quantifying resource protection needs and setting priorities, there is little emphasis on proving NbS impacts or their cost-effectiveness through robust M&E.

France offers a wide range of environmental management courses and training programs that incorporate NbS across undergraduate, graduate, postgraduate, and vocational levels, covering both technical and managerial aspects. Water agencies and state services benefit from a sufficient number of trained professionals to design, evaluate, and monitor projects while supporting implementers. However, this level of capacity is not always met at the level of local authorities. The Life-Artisan Project identified key capacity-related challenges in NbS implementation.[98] One major issue is the fragmentation of technical expertise, particularly in urban projects that require coordination with road infrastructure and urban planning regulations. Another challenge is the limited capacity to produce reliable financial estimates, often due to resource constraints during project design. Additionally, where implementers are small-scale local authorities, there is a shortage of professionals experienced in non-technical areas of NbS projects, such as engagement and coordination of diverse stakeholders.

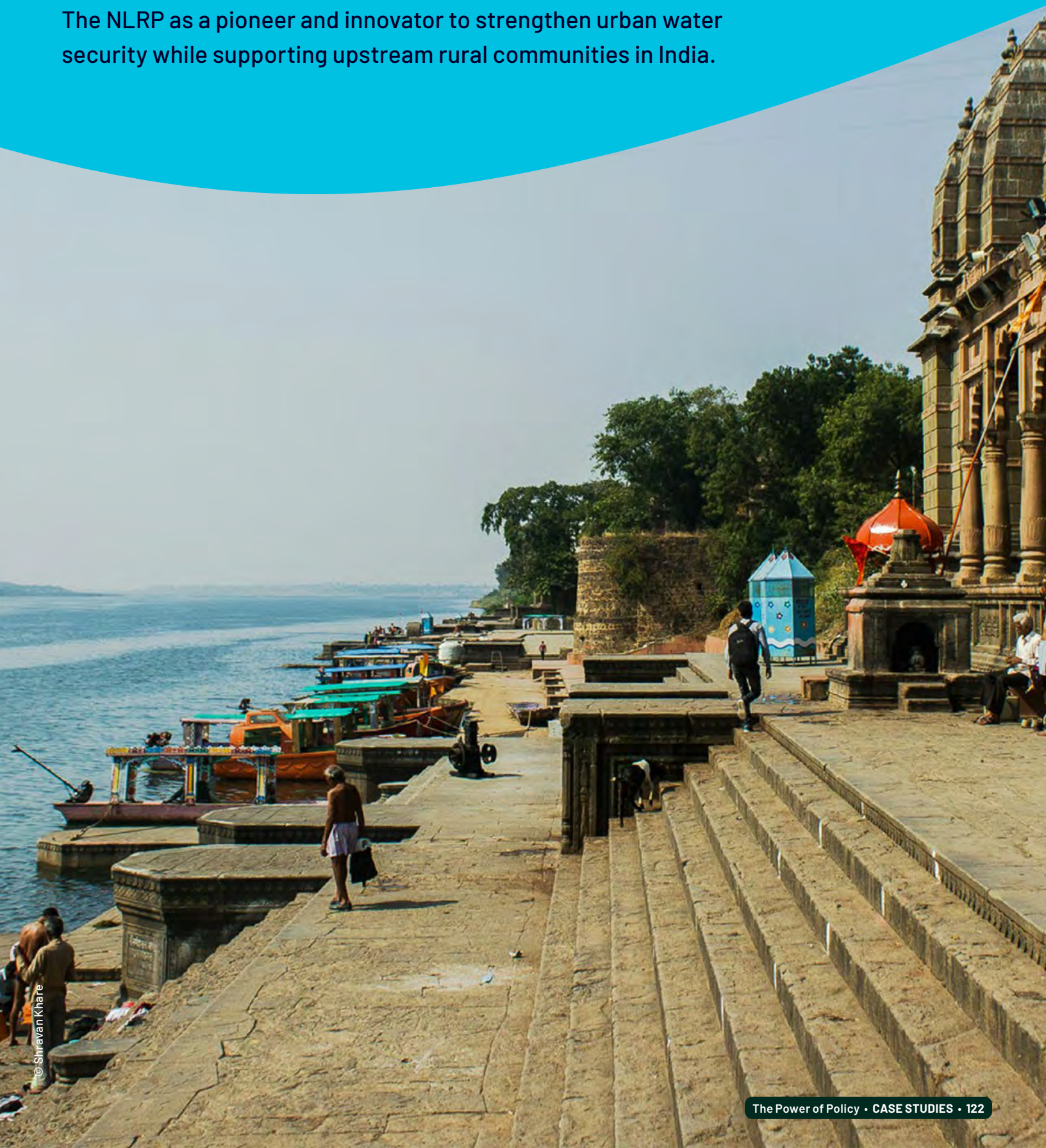
97 Schéma directeur d'aménagement et de gestion des eaux du bassin Loire-Bretagne. (2025). SDAGE 2022-2027. https://sdage-sage.eau-loire-bretagne.fr/home/le-sdage-2022-2027/les-documents-du-sdage-2022—-2027.html.

98 Etude sur les obstacles et leviers à la mise en œuvre des solutions fondées sur la nature pour l'adaptation au changement climatique, (2022) Office Français de la Biodiversité. https://www.ofb.gouv.fr/le-projet-life-integre-artisan/documentation-life-artisan/etude-sur-les-obstacles-et-leviers-la-0.

India

Narmada Landscape Restoration Project (NLRP)

The NLRP as a pioneer and innovator to strengthen urban water security while supporting upstream rural communities in India.



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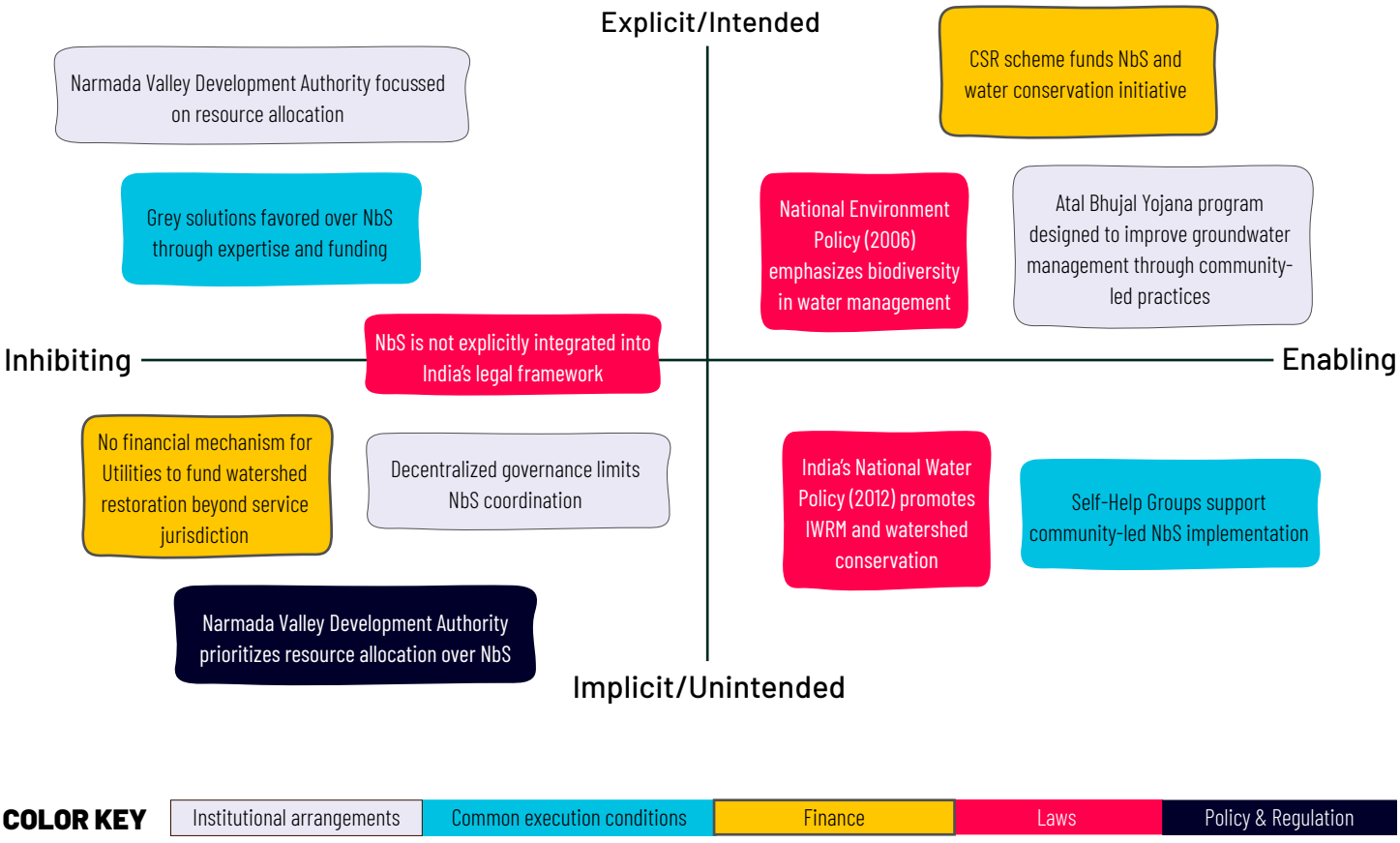
Context

Water Security: India faces growing water security challenges due to rapid population growth, climate variability, inefficient water use, and declining groundwater levels. The country is the world's largest consumer of groundwater, with agriculture using up to 80% of available water resources.[99] Per capita water availability has fallen significantly, driven by excessive extraction, competing demands, and inefficient irrigation practices. Future developments are also a cause for concern, with populations moving from rural to urban areas and growing demand from the technology industries.[100]

Water Resources Management: India's water governance is decentralized, with responsibilities distributed across central, state, and local authorities. While the National Water Policy (2012)[101] and initiatives like Atal Bhujal Yojana[102] promote groundwater management and conservation, there are limited frameworks for systematically implementing NbS. Institutional fragmentation, lack of coordination, and prioritization of grey infrastructure solutions have hindered NbS adoption at scale.



99 Dhawan, V. (2017). Water and agriculture in India: background paper for the South Asia expert panel during the Global Forum for Food and Agriculture (GFFA) 2017 . OAV German Asia-Pacific Business Association. https://www.oav.de/fileadmin/user_upload/5_Publikationen/5_Studien/170118_Study_Water_Agriculture_India.pdf.

100 Aravind, I. (2024, July 14). Thirst Trap: Water sustainability issues loom over India's booming data centre industry. The Economic Times. https://economictimes.indiatimes.com/news/india/thirst-trap-water-sustainability-issues-loom-over-indias-booming-data-centre-industry/articleshow/111718418.cms?from=mdr.

101 National Water Policy. (2012). Government of India. Ministry of Water Resources. https://nwm.gov.in/sites/default/files/national%20water%20policy%202012_0.pdf.

102 AMRUT 2.0: Operational Guidelines. (2021). Government of India, Ministry of Housing and Urban Affairs. https://mohua.gov.in/upload/uploadfiles/files/AMRUT-Operational-Guidelines.pdf.

Factsheet Summary	
Main facilitator	Global Green Growth Institute (GGGI) Indian Institute of Forest Management National Thermal Power Corporation (NTPC) USAID Self-Help Groups (SHGs)
Primary Water Objective	Water resources quantity
Catchment/watershed management or 'End-of-pipe'	Watershed/catchment management, Water resource management
NbS Category	Land management
Co-benefits	People-based co-benefits (improved resource rights, participation in decision-making, livelihoods)
Solution adopted at scale?	No, but pilot efforts are influencing national water security discussions

The Case Study

The decline in groundwater levels, coupled with rising industrial and domestic demand, poses severe challenges for cities like Indore (2 million inhabitants), which depends on the Narmada River for more than 90% of its drinking water supply. In response, the Narmada Landscape Restoration Project (NLRP), initiated by the Global Green Growth Institute (GGGI), integrates community participation and Corporate Social Responsibility (CSR) funding to drive water conservation efforts. The project's geographical scope covers the critical section of the Narmada River that supplies Indore's municipal water utility. Key interventions focus on sustainable agroforestry, reduced chemical inputs in agriculture, afforestation, and land-use planning to enhance water retention and improve water quality. Initial results show a 25% reduction in runoff pollution and a 20% increase in available water resources within targeted conservation areas.[103] The project also sought to establish a financial linkage between Indore's urban water users and upstream rural communities through a Payment for Ecosystem Services (PES) model, though implementation challenges have led to a pivot toward alternative incentive-based mechanisms.[104]

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Relevance to National Context: While NbS are not yet mainstreamed in India's water management frameworks, municipal corporations are increasingly exploring alternatives like Non-Revenue Water (NRW) reduction, rainwater harvesting, and traditional water conservation techniques. The NLRP is one of the first projects to attempt linking upstream ecosystem restoration with downstream urban water security. It also seeks alignment with India's national programs ("missions"), which are progressively shifting toward a more long-term, environment-sensitive water governance approach.[105]

103 Monitoring and Evaluation Framework for the Narmada Landscape Restoration Project (NLRP). (2022). Global Green Growth Institute. Indian Institute of Forest Management. https://gggi.org/wp-content/uploads/2022/01/NLRP_Jan22.pdf.

104 Ibid.

105 Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation. (2021). Government of India. National Water Mission: Mission Document. https://nwm.gov.in/sites/default/files/Revised%20Mission%20Document.pdf.

Enabling Conditions

Law: National legislation relevant to water management includes the Environmental Protection Act[106] and the Forest Conservation Act,[107] which provide legal frameworks for ecological restoration. The absence of a dedicated legal framework for NbS limits their integration into mainstream water resource management. Weak enforcement mechanisms and fragmented institutional mandates further inhibit their implementation. Land ownership complexities and regulatory gaps also create barriers, as NbS often require coordinated action across administrative boundaries. It is worth noting that India's water governance is guided by the National Water Policy (2012), which promotes sustainable water use but lacks explicit provisions for NbS and was never formally enacted as law.[108]

Policy and Regulation: While India's policy framework acknowledges ecological approaches to water security, regulatory fragmentation has hindered the integration of NbS into mainstream planning. The National Mission for Clean Ganga (NMCG)[109] provides a model for river restoration, but its institutional framework remains an exception rather than the norm. There is no unified watershed-level governance structure to oversee water conservation, with most existing frameworks being specific to one area and focused on water allocation and infrastructure development rather than ecological restoration. National-level initiatives such as those led by the National Institute of Agricultural Extension Management (MANAGE)[110] and the National Innovations in Climate Resilient Agriculture (NICRA)[111] promote water efficiency through best agricultural practices. Additionally, the Indian government provides subsidies for micro-irrigation systems such as drip and sprinkler irrigation. However, these programs primarily target individual farmers and do not address broader watershed-scale conservation efforts, making initiatives like the NLRP essential for scaling up landscape-level interventions. However, the original PES model promoted by the NLRP remained unrealized due to regulatory and institutional barriers. Existing regulations do not allow urban water utilities to allocate funds for conservation activities beyond their service areas. Consequently, the project has pivoted toward an incentive-based mechanism, seeking alternative ways to operationalize a rural-urban financial connection to support watershed restoration.[112]

Funding and Finance: The NLRP project faced challenges in accessing funding schemes based on user fees. More broadly, NbS financing for water security in India remains underdeveloped, relying heavily on international donors, Corporate Social Responsibility (CSR) funding, and limited public investment.[113] While India mandates large companies to allocate 2% of net profits to social and environmental causes under its CSR legislation,[114] only a small portion of these funds is directed toward water security initiatives. Municipal water utilities, struggling to achieve cost recovery, face further constraints in financing NbS projects. Expanding Payment for Ecosystem Services models, climate resilience grants, and blended finance approaches could strengthen investment in NbS. CSR funding has played a key role in bridging financial gaps for water conservation projects, with NTPC (a major hydropower producer) supporting the NLRP. The project's shift from a PES model to an incentive-based approach underscores the complexity of establishing sustainable financial mechanisms to connect urban water users with upstream rural conservation efforts.

Institutional Arrangements: Water governance in India involves a large number of actors, including the Ministry of Jal Shakti, State water departments, and municipal corporations. However, NbS-related interventions often lack clear institutional leadership, and there is no unified monitoring system for water resources quantity. The NLRP had to create its own coordination mechanisms, engaging urban and rural stakeholders through partnerships and investing significant resources into stakeholder mobilization. It also had to create its own monitoring scheme and to generate evidence on the efficiency of their activities. The project highlights the need for watershed-scale governance structures that bridge the gap between upstream conservation and downstream water use. Community-based governance through Self-Help Groups

106 Environmental Protection Act. (1986, amended in 2006). Government of India. https://www.indiacode.nic.in/bitstream/123456789/6196/1/the_environment_protection_act%2C1986.pdf.

107 Forest Conservation Act. (1980). Government of India. https://www.indiacode.nic.in/bitstream/123456789/19381/1/the_forest_%28conservation%29_act%2C_1980.pdf.

108 National Water Policy. (2012). Government of India, Ministry of Water Resources. https://nwm.gov.in/sites/default/files/national%20water%20policy%202012_0.pdf.

109 https://www.nmcg.nic.in/.

110 National Institute of Agricultural Extension Management. (2025). Government of India, Ministry of Agriculture & Farmers Welfare. https://www.manage.gov.in/.

111 Press Information Bureau. (2021, August 6). National Innovation on Climate Resilient Agriculture. Ministry of Agriculture and Farmers Welfare, Government of India. https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1743354.

112 Sengar, A.S. (2022). PES Approach for Mitigating Water Scarcity in Madhya Pradesh: Case of the Narmada Landscape Restoration Project. Indian Institute of Forest Management and Global Green Growth Institute.

113 Nature-based Solutions: A review of key issues in India. (n.d.). UK Government, Foreign, Commonwealth & Development Office. https://ioraecological.com/wp-content/uploads/2022/09/Nature-based-Solutions.-A-review-of-key-issues-in-India.pdf.

114 The Companies Act. (2013). Provides for CSR under section 135. https://www.indiacode.nic.in/bitstream/123456789/2114/5/A2013-18.pdf.

(SHGs) has been instrumental in the project's success.[115] SHGs, which are widely recognized and supported across India, provide a decentralized mechanism for engaging rural stakeholders.

Common Execution Conditions: Barriers to NbS implementation in India mostly relate to the overwhelming predominance of grey infrastructure. Grey infrastructure solutions benefit from a well-established community of practice, widespread technical expertise, streamlined procurement procedures, and well-integrated budgeting frameworks. They also receive strong political support, having long been the default approach in water management, with historical precedence fostering trust and collaboration among stakeholders. Their familiarity and institutional backing make implementation relatively straightforward, with clear regulatory pathways and funding mechanisms in place. In contrast, NbS face significant barriers to adoption, leaving projects like the NLRP to self-organize, mobilize significant resources to allow coordination at watershed scale, and push for their own recognition in broader planning efforts.

115 Narmada Landscape Restoration Project (NLRP): Half-Yearly Newsletter, July-December 2023. (2023). Global Green Growth Institute (GGGI). https://ntpc.co.in/sites/default/files/inline-files/Narmada%20Landscape%20restoration%20Project%20Half%20Yearly%20Newsletter.pdf.

Kenya

Restoration of degraded lands in the watershed to enhance water security for Eldoret-Iten

Restoration of degraded lands in a watershed with a special focus on sustainable land management practices.

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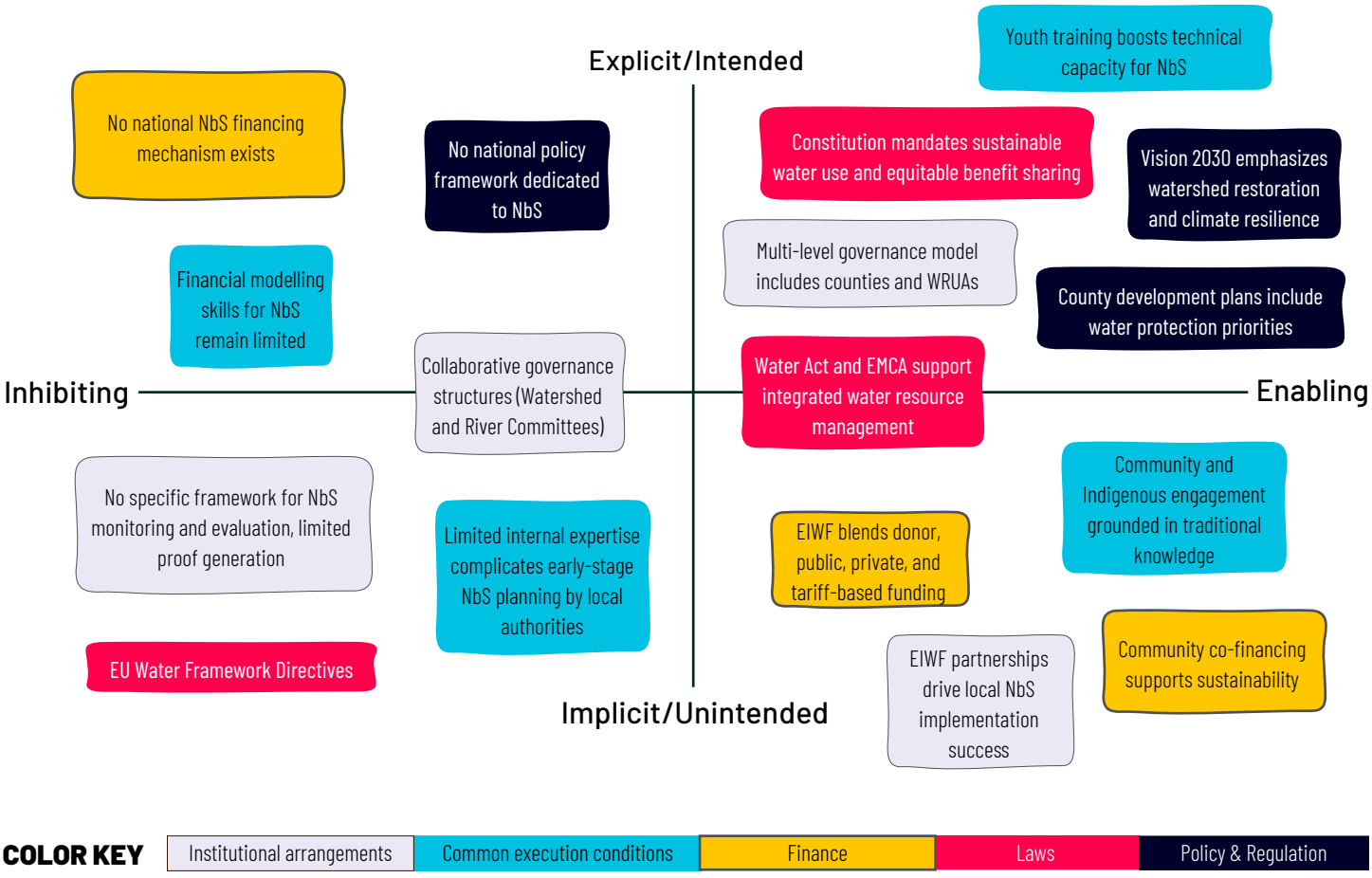
Context

Water Security: Kenya faces severe water scarcity, with per capita freshwater availability projected to decline further due to climate change and population growth.[116] As of 2024, only 72% of the population has access to safe drinking water, while only 29% have access to improved sanitation.[117] Rapid urbanization exacerbates water challenges, particularly in Eldoret, western Kenya's commercial hub. Eldoret's reliance on three major natural water towers—the Cherangany Hills, Elgeyo Hills, and Northern Mau Forest—highlights the need for sustainable watershed management to protect water flow and quality. The region's water security is further strained by agricultural runoff, deforestation, and pollution from expanding human settlements.

Water Resources Management: Water governance in Kenya operates under a multi-tiered system guided by the 2010 Constitution. The national government is responsible for policy development through the Ministry of Water, Sanitation and Irrigation, while regulatory oversight is provided by the Water Resources Authority (WRA) and the Water Services Regulatory Board (WASREB). Local-level water management is primarily handled by Water Resource Users Associations (WRUAs), voluntary associations formed around sub-catchment areas. The WRUAs are community-based, voluntary associations made up of water users and riparian owners. These WRUAs play a critical role in community engagement and the enforcement of water conservation measures. Despite this institutional framework, weak coordination, fragmented policies, and inadequate funding limit the effectiveness of water resource management. The Kenya National Water Resources Management Strategy[118] developed by the Ministry of Water, Sanitation, and Irrigation with the aim to strengthen the activities of the WRA, provides the overarching policy framework for water resource management and development in Kenya.



116 WWF-Kenya. (n.d.). Journey of Water. https://www.wwfkenya.org/our-work/our-campaigns/journey-of-water/.

117 Impact Report Issue No. 16. (n.d.). Water Services Regulatory Board. https://wasreb.go.ke/impact-reports-issue-no-16/.

118 Ministry of Water, Sanitation and Irrigation. (2021). The National Water Resources Strategy (2020–2025). Government of Kenya. https://faolex.fao.org/docs/pdf/ken214249.pdf.

Factsheet Summary	
Main facilitator	The Nature Conservancy Eldoret Water and Sanitation Company (ELDOWAS) Iten-Tambach Water and Sewerage Company WRUAs
Primary Water Objective	Water resource quality and quantity
Catchment/watershed management or 'End-of-pipe'	Watershed/catchment management, source water protection, water resource management
NbS Category	Habitat restoration and Land management
Co-benefits	Biodiversity, Economic benefits, People-based co-benefits (improved decision-making, resource rights, recreational/spiritual value)
Solution adopted at scale?	Yes. The water fund model has expanded engagement with 20,000 households, protecting critical watersheds.

The Case Study

The Eldoret-Iten Water Fund (EIWF) was established to restore degraded lands in the upstream watershed areas that supply Eldoret's water needs. The initiative is led by TNC in partnership with ELDOWAS, county governments, local government agencies and local WRUAs, as well as Community Forest Associations (CFAs). The fund supports a range of NbS interventions, including riparian buffer restoration, afforestation, and soil conservation. The approach includes an incentive-based conservation model, where farmers receive free seedlings and technical training in exchange for adopting sustainable land use practices. The EIWF has already restored more than 51,000 hectares of degraded land, rehabilitated 230 km of riparian areas, and engaged 20,000 households in conservation efforts. EIWF has significantly exceeded its initial conservation targets, restoring more than 51,000 hectares of degraded land (269% of the goal), rehabilitating 230 km of riparian buffers, and improving water security for more than 130,000 people. Additionally, 496 water pans have been constructed, increasing local water storage capacity by 56.268 million litres.

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Relevance to the National Context: The Kenya National Water Resources Management Strategy provides the overarching policy framework for water resource management and development in Kenya, with the National Environment Policy (NEP)[119] providing an important framework through an ecosystem approach. EIWF aligns with Kenya's broader environmental and development priorities, including Vision 2030,[120] which emphasizes watershed restoration and climate resilience. The initiative also contributes to national afforestation targets, as Kenya aims to plant 15 billion trees by 2032. The approach taken by EIWF provides valuable lessons for scaling up similar initiatives in other regions.

119 National Environment Policy 2013. (2013, January 1).UN Environment Programme. https://leap.unep.org/en/countries/ke/national-legislation/national-environment-policy-2013.
120 Kenya Vision 2030. https://vision2030.go.ke/.

Enabling Conditions

Law: The Constitution of Kenya of 2010[121] provides the basis for natural resource management in the country. The state has the obligation to ensure that water is conserved, that development is managed to be sustainable and to ensure that the benefits accrued are shared equitably. While it is noted that the utilization of natural resources should be for the benefit of the people of Kenya, there is important emphasis placed upon the needs of marginalized communities. Kenya's legal framework for NbS is anchored in the Environmental Management and Coordination Act of 1999[122] and the Water Act of 2016.[123] These laws mandate integrated water resource management and give regulatory authority to WRA. However, overlapping institutional mandates and challenges in enforcing riparian zone protections further hinder effective implementation of NbS projects.

Policy and Regulation: County governments integrate the Vision 2030 water resource protection priorities into their County Integrated Development Plans (CIDPs), which provide a roadmap for local-level environmental planning. However, there is no dedicated policy or financial framework to mainstream NbS at the national level, making it difficult to secure long-term funding for projects like EIWF. Under the Water Act of 2016, the Regional and Sub-Regional Offices of the WRA and the WRUAs are responsible for regulation of water use. While WRUAs facilitate local engagement, their effectiveness is often limited by funding constraints and capacity gaps.

Funding and Finance: EIWF employs a blended financing model that combines grants from international donors, contributions from the private sector, county governments and community co-financing. The fund also receives financial support from water tariffs collected by ELDOWAS. However, the absence of a national financing mechanism for NbS remains a barrier to scaling up interventions. Exploring innovative mechanisms for financing through carbon credits, conservation payments, and leveraging the solid waste management fund could provide opportunities to support NbS.

Institutional Arrangements: The 2010 Constitution provides for two tiers of government, with national government being broadly responsible for policy development, and the next tier of government responsible for regulation to ensure that policies are effectively implemented. Kenya's decentralized governance structure assigns water resource management responsibilities to both national and county governments. EIWF's governance model, which includes partnerships with county governments, research institutions, and community groups, has demonstrated success in implementing NbS. However, bureaucratic inefficiencies and slow procurement processes continue to delay project implementation.

Common Execution Conditions: EIWF has successfully mobilized local communities, working with farmers, Indigenous groups, and youth organizations to promote conservation practices. These are deeply linked to Indigenous knowledge and cultural traditions, particularly among communities such as the Ogiek, Sengwer, and Cherangany, who have historically played a role in protecting water sources. However, cultural perceptions sometimes pose challenges, as some tree species used in restoration efforts are associated with negative beliefs, affecting adoption rates. EIWF has leveraged social influence by engaging elite Kenyan athletes in conservation campaigns. Additionally, capacity-building has been a key focus, with EIWF training local youth as technical assistants and drone operators for watershed monitoring. However, technical gaps persist, particularly in areas such as financial modeling for NbS investments and integrating NbS into broader economic planning. Strengthening training programs and institutional knowledge-sharing will be critical for scaling up similar initiatives. Despite strong engagement, ensuring long-term participation requires sustained financial incentives and institutional support.

121 Republic of Kenya. (2010). The Constitution of Kenya, 2010. Kenya Parliament. https://www.parliament.go.ke/sites/default/files/2023-03/The_Constitution_of_Kenya_2010.pdf.

122 Environmental Management and Co-ordination Act, 1999. (1999). Government of Kenya. https://kenyalaw.org/kl/fileadmin/pdfdownloads/Acts/EnvironmentalManagementandCo-ordination.pdf.

123 The Water Act 2016. (2016). Government of Kenya, Water Resources Authority. https://wra.go.ke/download/the-water-act-2016/.

Netherlands

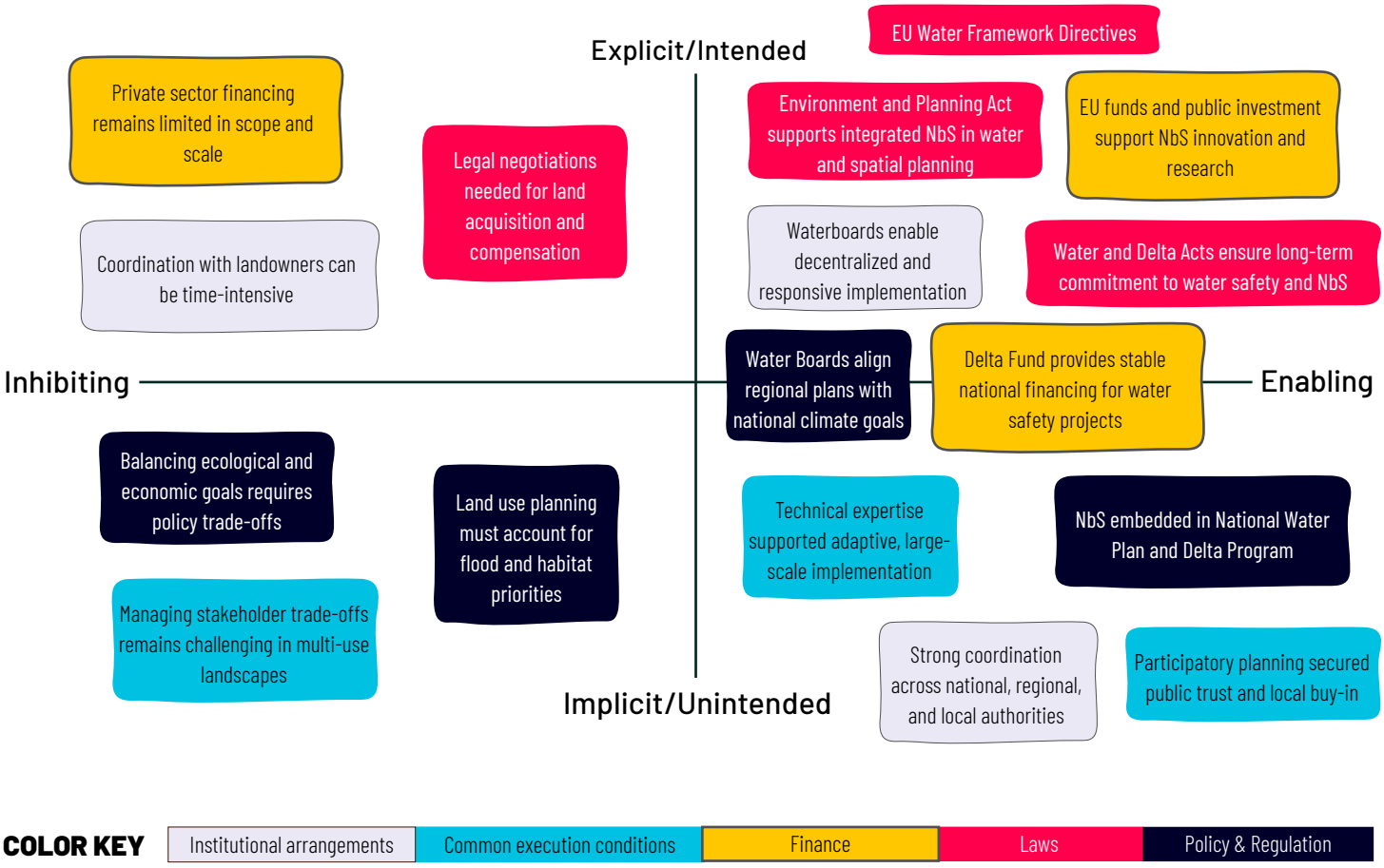
Integrating nature-based flood management into national policy and plans

The Netherlands' 'Room for the River' program integrates nature-based flood management to mitigate risks while restoring ecosystems and enhancing climate resilience.

Context

Water Security: The Netherlands has a unique relationship with water due to its low-lying geography, which makes it highly vulnerable to flooding. Situated in the delta of the Rhine, Meuse, and Scheldt rivers, the country faces compound flood risks, including coastal, fluvial, and pluvial flooding. More than 50% of the land is prone to flooding, requiring continuous and adaptive water management strategies. While the traditional approach relied on dike reinforcements, increasing climate variability and land subsidence necessitated a shift toward integrated flood management that works with natural processes rather than against them.

Water Resources Management: The Netherlands has a long history of water governance, evolving from early water boards in the 12th century to a highly sophisticated multi-level governance structure today.[124] The national government, through Rijkswaterstaat, leads policy and infrastructure planning, while regional water boards manage implementation and maintenance. The 1993 and 1995 catastrophic floods in the Rhine watershed triggered a paradigm shift in Dutch flood policy, leading to the recognition that reinforcing dikes alone was insufficient to manage risks. This realization laid the foundation for the Room for the River program, a national initiative aimed at adapting to higher peak river discharges by allowing rivers more space in their floodplains.



124 van Popering-Verkerk, J., & van Buuren, M.W. (2013). Integrated Water Resources Management in the Netherlands. Historical trends and current practices in the governance of integration. International Journal of Water Governance, Volume 1, Issue 3/4, p. 427-452. Erasmus University Repository. https://repub.eur.nl/pub/41249.

Factsheet Summary	
Main facilitator	Ministry of Infrastructure and Water Management (Rijkswaterstaat)
Primary Water Objective	Flood mitigation (Water resources quantity)
Catchment/watershed management or 'End-of-pipe'	Watershed/catchment management, Water resource management
NbS Category	Habitat restoration, Land management
Co-benefits	Flood mitigation, Biodiversity, People-based co-benefits (improved resource rights, decision-making participation, recreation)
Solution adopted at scale?	Yes, through large-scale national policies and regional programs

The Case Study

The Room for the River program,[125] launched in 2000, represents a transformative shift in Dutch flood management. Instead of relying solely on dike reinforcement to resist flooding, the program creates floodplains, bypasses, and natural water retention areas, to store and thus reduce water levels during peak flows. The initiative included 34 projects along the Rhine, Maas, and IJssel rivers, integrating NbS such as wetland restoration, river widening, and floodplain lowering. These interventions not only reduce flood risks but also improve biodiversity, water quality, and public access to green spaces. The program has successfully enhanced flood safety while promoting ecological and social benefits, reinforcing the Netherlands' global leadership in integrated water management.

Relevance to National Context: The program aligns with the Netherlands' broader water management strategy, which integrates climate adaptation, water safety, and spatial planning. The National Water Plan 2022-2027[126] prioritizes a safe, climate-resilient delta, recognizing NbS as a core element of flood risk management. Additionally, the country's commitment to EU directives, such as the Water Framework Directive and the Floods Directive, has supported NbS adoption. With climate change driving more extreme weather, Room for the River provides a replicable model for balancing water security with environmental restoration.

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125 Room for the River. (2025). Holland – Land of Water. https://www.hollandlandofwater.com/ruimte-voor-de-rivier/.

126 Nationaal Water Programma 2022-2027. (n.d.). Rijksoverheid. https://open.overheid.nl/documenten/ronl-0c5086b3029ab6a4ab28d52838ce44d5e6285d1a/pdf.

Enabling Conditions

Law: Dutch water legislation is guided by the Environment and Planning Act (Omgevingswet) of 2024.[127] This act consolidates regulations on spatial planning, environmental protection, and water management, supporting holistic NbS integration. The Water Act (2009)[128] outlines responsibilities for national, provincial, and local water management, while the Delta Act[129] provides long-term financial and policy commitments to water safety. The alignment of national legislation with EU directives further reinforces the institutional framework for NbS.

Policy and Regulation: The Room for the River approach is embedded in national water policy, ensuring continued integration into flood risk management strategies. The Dutch government publishes a National Water Program[130] every six years, outlining policy ambitions for climate adaptation, freshwater distribution, and flood resilience. Water boards develop regional water management plans aligned with national priorities described in the National Water Program. The Delta Program, a long-term initiative included in successive National Water Programs, continues to advance NbS by integrating flood protection with ecological and urban development objectives.

Funding and Finance: The Room for the River program had a budget of €2.3 billion, funded primarily by the national government through the Delta Fund,[131] a dedicated financial mechanism for water safety investments. Water boards also contributed resources, while EU funding supported research and innovation. The Netherlands has explored mixed public-private financing models, but large-scale NbS investments remain primarily publicly funded. Expanding financial instruments, such as climate bonds and ecosystem service payments, could enhance long-term NbS sustainability.

Institutional Arrangements: The Netherlands' water governance structure is decentralized yet highly coordinated. Rijkswaterstaat leads national policy, while water boards, provincial authorities, and municipalities handle regional and local implementation. The Unie van Waterschappen (Association of Water Boards) facilitates coordination between different governance levels. Collaboration between scientific institutions, engineering firms, and environmental organizations has further strengthened NbS implementation.

Common Execution Conditions: The successful execution of Room for the River relied on multi-stakeholder collaboration, technical expertise, and adaptive management. However, challenges such as land acquisition, compensation for displaced landowners, and balancing economic interests with ecological goals required extensive negotiations. Public acceptance was critical, with participatory planning ensuring community buy-in. The program's success has inspired international replication, demonstrating the effectiveness of NbS in large-scale flood risk management.[132,133]

127 Environment and Planning Act of The Netherlands. (2024). Informatiepunt Leefomgeving. https://iplo.nl/regelgeving/omgevingswet/english-environment-and-planning-act/.

128 Water Act. (2010). Ministry of Transport, Public Works and Water Management. https://ocw.tudelft.nl/wp-content/uploads/The_Dutch_Water_Act.pdf.

129 Government of the Netherlands. (n.d.). What does the Delta Act cover? Delta Programme. https://english.deltaprogramma.nl/faq/frequently-asked-questions-about-the-delta-programme/what-is-set-down-in-the-delta-act.

130 National Water Programme 2022-2027. (2022, March 18). FAO. https://www.fao.org/faolex/results/details/fr/c/LEX-FAOC217243/.

131 Complete Delta Programme 2025 version. (2025). National Delta Programme. https://english.deltaprogramma.nl/documents/publications/2024/09/17/dp2025-complete-version.

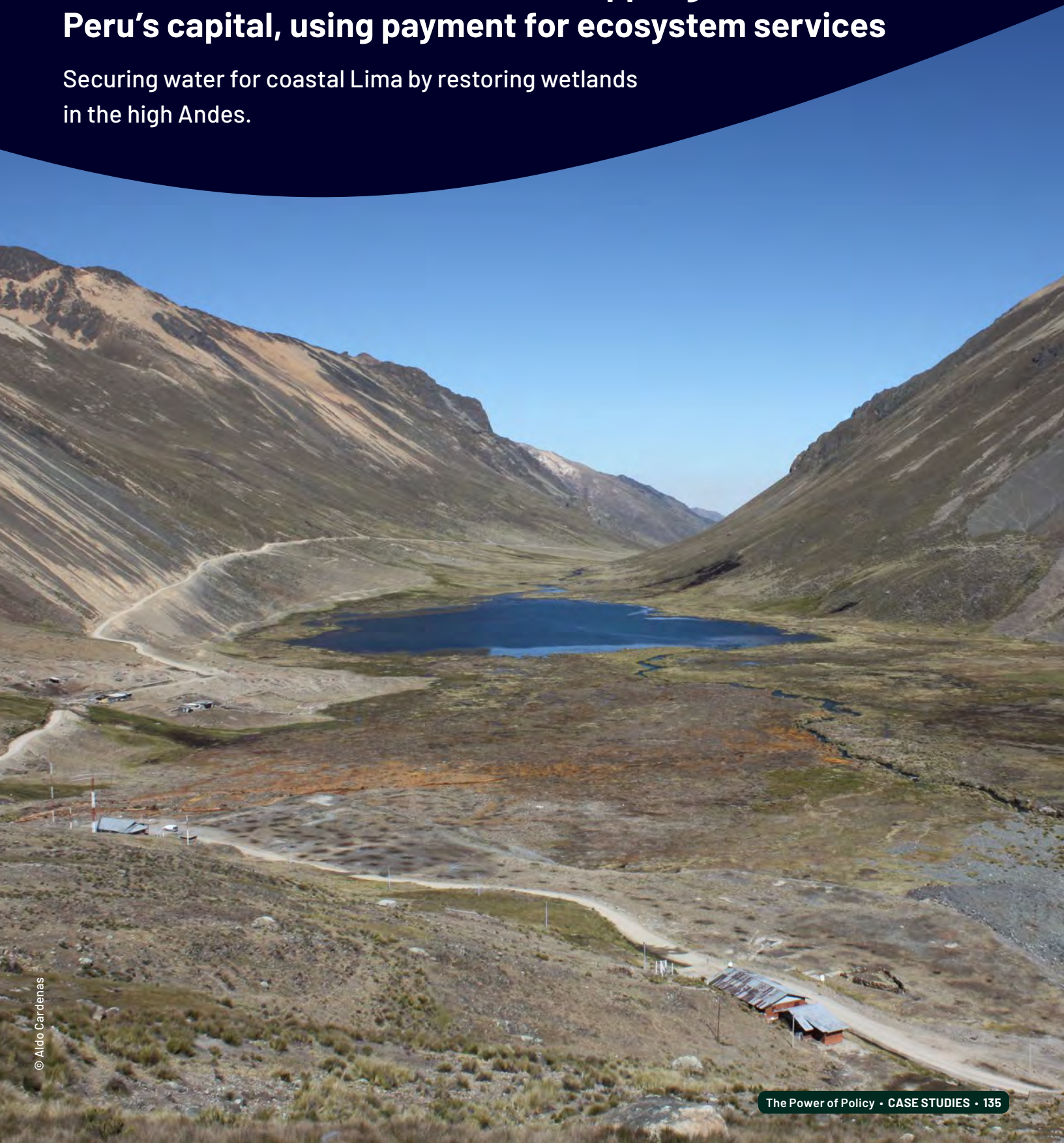
132 Formal evaluation report for Ruimte voor de Rivier. (2018, February 14). Berenschot. https://zoek.officielebekendmakingen.nl/blg-836991.pdf.

133 Rivers2Morrow. (n.d.) NCR Knowledge Base. https://kbase.ncr-web.org/rivers2morrow/.

Peru

Restoration and conservation of the Carampoma wetlands in Huarochirí Province, suppling water to Peru's capital, using payment for ecosystem services

Securing water for coastal Lima by restoring wetlands in the high Andes.



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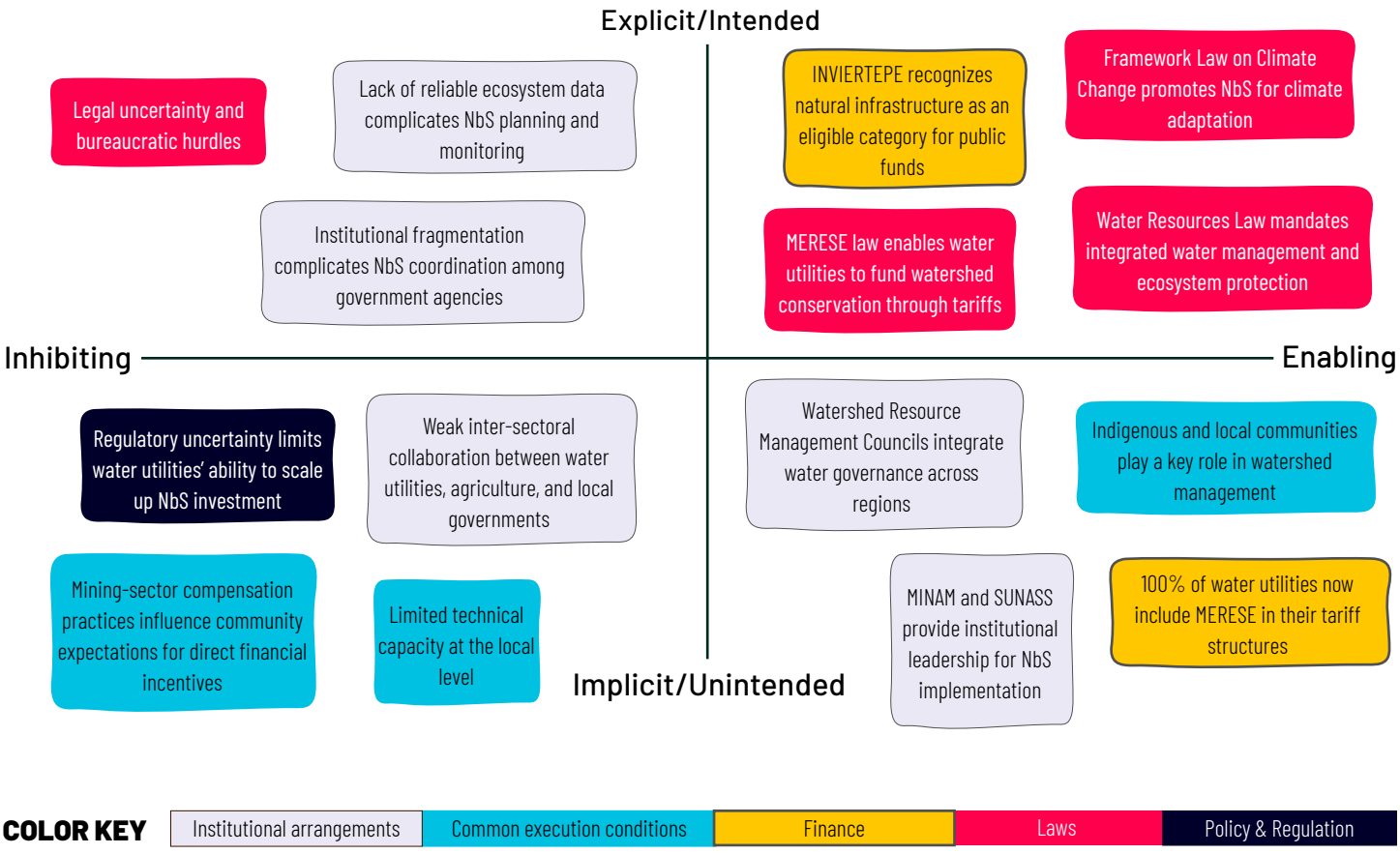
Context

Water Security: Peru faces significant water security challenges due to its geographic and climatic conditions. The country is divided into three major hydrological regions: Pacific, Amazon, and Titicaca, with 97% of its water resources located in the Amazon basin, where only 26% of the population lives. Meanwhile, the Pacific region, home to 66% of the population, has access to only 2% of the country's water resources.[134] Climate change is exacerbating these challenges, leading to glacier retreat, altered precipitation patterns, and increased frequency of extreme weather events such as droughts and floods. The capital city, Lima, depends on the natural watersheds of the Chillón, Rímac, and Lurín rivers, as well as on the Alto Mantaro through water transfers. These watersheds are under growing pressure from climate change, urban expansion, and ecosystem degradation.

Water Resources Management: Peru has a comprehensive legal framework for water management, with the Water Resources Law[135] establishing the National Water Authority as the governing body for water resource management. The country also recognizes natural infrastructure as a strategic asset, allowing water utilities to invest in conservation through MERESE, a financial mechanism that integrates the cost of conservation into water tariffs. The SUNASS oversees tariff regulation, ensuring that water utilities incorporate ecosystem conservation into their financial planning. Additionally, the government promotes community participation through regional water councils (CRHC), which facilitate integrated water governance at the regional level.



134 Burstein-Roda, T. (2018). Reflexiones sobre la gestión de los recursos hídricos y la salud pública en el Perú. Revista Peruana de Medicina Experimental y Salud Pública, 35(2), 297–303. https://rpmesp.ins.gob.pe/index.php/rpmesp/article/view/3641.

135 Congreso de la República del Perú. (2009). Ley de Recursos Hídricos, Ley N.º 29338. Diario Oficial El Peruano. https://www.ana.gob.pe/sites/default/files/archivos/paginas/LEY%20DE%20RECURSOS%20HIDRICOS%20RRHH%2029338.pdf.

Factsheet Summary	
Main facilitator	Ministry of the Environment (MINAM) National Superintendence of Sanitation Services (SUNASS) Water Utilities (EPS) Local Communities Watershed Resource Management Councils (CRHC)
Primary Water Objective	Water resources quantity
Catchment/watershed management or 'End-of-pipe'	Watershed/catchment management, Source water protection
NbS Category	Habitat restoration (wetland restoration), Land management (agricultural best management practices–BMPs)
Co-benefits	Biodiversity, Community participation, Improved water retention, Sustainable land use
Solution adopted at scale?	No, but Payment for Ecosystem Services (MERESE) mechanism is influencing national water security strategies

The Case Study

The Milloc Project, located in the Carampoma wetlands of Huarochirí Province, is a pilot initiative financed through MERESE to restore degraded wetland ecosystems that supply water to Lima. The project involves high Andean communities, Lima Potable Water and Sewer System Service (SEDAPAL), and SUNASS working together to enhance water retention capacity, reduce erosion, and improve water availability. SEDAPAL, allocates 1% of water and sanitation tariffs to fund conservation projects such as Milloc. This model provides a sustainable financing mechanism for NbS, demonstrating how wetland restoration can increase water availability.

Relevance to National Context: The Milloc Project is aligned with Peru's commitment to integrating natural infrastructure into water security strategies. The Framework Law on Climate Change and the National Climate Change Adaptation Plan explicitly promote the use of NbS to mitigate climate risks.[136] MERESE provides a structured mechanism for water utilities to invest in upstream watershed conservation, offering a replicable model for other urban areas facing water security challenges.[137] However, the effectiveness of these initiatives depends on strengthening institutional coordination and technical capacity at the local level.

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136 Congreso de la República del Perú. (2018). Ley Marco sobre Cambio Climático, Ley N.º 30754. Diario Oficial El Peruano. https://www.gob.pe/institucion/presidencia/normas-legales/355750-30754.

137 Superintendencia Nacional de Servicios de Saneamiento. (2024). Dirección de Ámbito de la Prestación – Merese hídricos. Plataforma del Estado Peruano. https://www.gob.pe/qu/70492-superintendencia-nacional-de-servicios-de-saneamiento-merese-hidricos.

Enabling Conditions

Legislation: Peru has a strong legal foundation for NbS investments, including the Water Resources Law, which mandates integrated water resource management, the Sanitation Services Framework Law and the MERESE Law,[138] which enables ecosystem service compensation mechanisms. The National System of Public Investment known as Invierte.pe recognizes natural infrastructure as an eligible investment category, allowing public funds to be allocated to conservation projects. This favorable regulatory framework has facilitated the expansion of MERESE, with institutional leadership from MINAM and SUNASS supporting its implementation. However, legal uncertainty, bureaucratic hurdles and the lack of capacity in water utilities continue to pose challenges for the large-scale adoption of NbS. Strengthening the legal framework to streamline approvals, reduce institutional fragmentation and maintain trained personnel would help accelerate NbS investment.

Policy and Regulation: Peru's national water policy framework includes provisions for financing NbS, but the practical implementation of these strategies remains uneven. While SEDAPAL has integrated MERESE into its investment plans, smaller water utilities have been slower to adopt this approach due to limited financial resources, capacity, and regulatory challenges. The CRHC plays an important role in integrating watershed management into water governance, but its effectiveness varies across regions. Inter-sectoral collaboration, particularly between water utilities, agriculture, energy companies, and local governments, has been critical for projects like Milloc, where local communities manage highland ecosystems that supply water to Lima. However, technical capacity constraints, a lack of reliable ecosystem data, and institutional fragmentation among different government agencies continue to hinder effective planning and monitoring of NbS projects.

Funding and Finance: Public resources are the main source of funding for NbS in Peru,[139] with national programs supporting their implementation. Among water utilities, MERESE is the primary financing mechanism, and as of 2024, 100% of Peru's water utilities have tariff structures that include MERESE, with 32 out of 50 utilities already implementing these funds for watershed restoration projects. Additional funding comes from international cooperation programs and public-private partnerships, but smaller utilities often struggle to accumulate sufficient resources for meaningful ecosystem restoration efforts. Expanding access to climate adaptation funds and green bonds could enhance the financial sustainability of NbS initiatives. Strengthening financial planning and diversifying funding sources will be essential to scaling up NbS adoption.

Institutional Setup: Water governance in Peru involves multiple actors, including the National Water Authority, regional water councils, EPS, and municipal and regional governments. While national policies support NbS, their implementation depends on local institutions with varying levels of capacity. The Milloc Project illustrates the importance of multi-stakeholder coordination, as water utilities, regulators, and community organizations must work together to sustain wetland restoration efforts. However, institutional fragmentation and resistance from certain sectors, such as agriculture, have slowed the integration of NbS into mainstream water management. Strengthening the role of regional water councils and reinforcing MERESE implementation at a broader scale could improve coordination and effectiveness.

Common Execution Conditions: The Milloc Project has faced challenges in data availability, hydrological monitoring, and long-term ecosystem management. In some Andean communities, expectations for direct compensation—shaped by mining-sector practices—have complicated negotiations over conservation incentives. Addressing these challenges requires enhanced technical training, better ecosystem data, and long-term financial planning. Peru has made significant progress in integrating NbS into its water security framework, but scaling up remains a challenge. Improved regulatory clarity, strengthened technical capacities, and stable financing mechanisms, together with robust evidence of the benefits of NbS, are needed to support decision-making and investment. Expanding NbS-focused public investments and institutionalizing NbS as a central component of Peru's water security strategy will be key to long-term success.

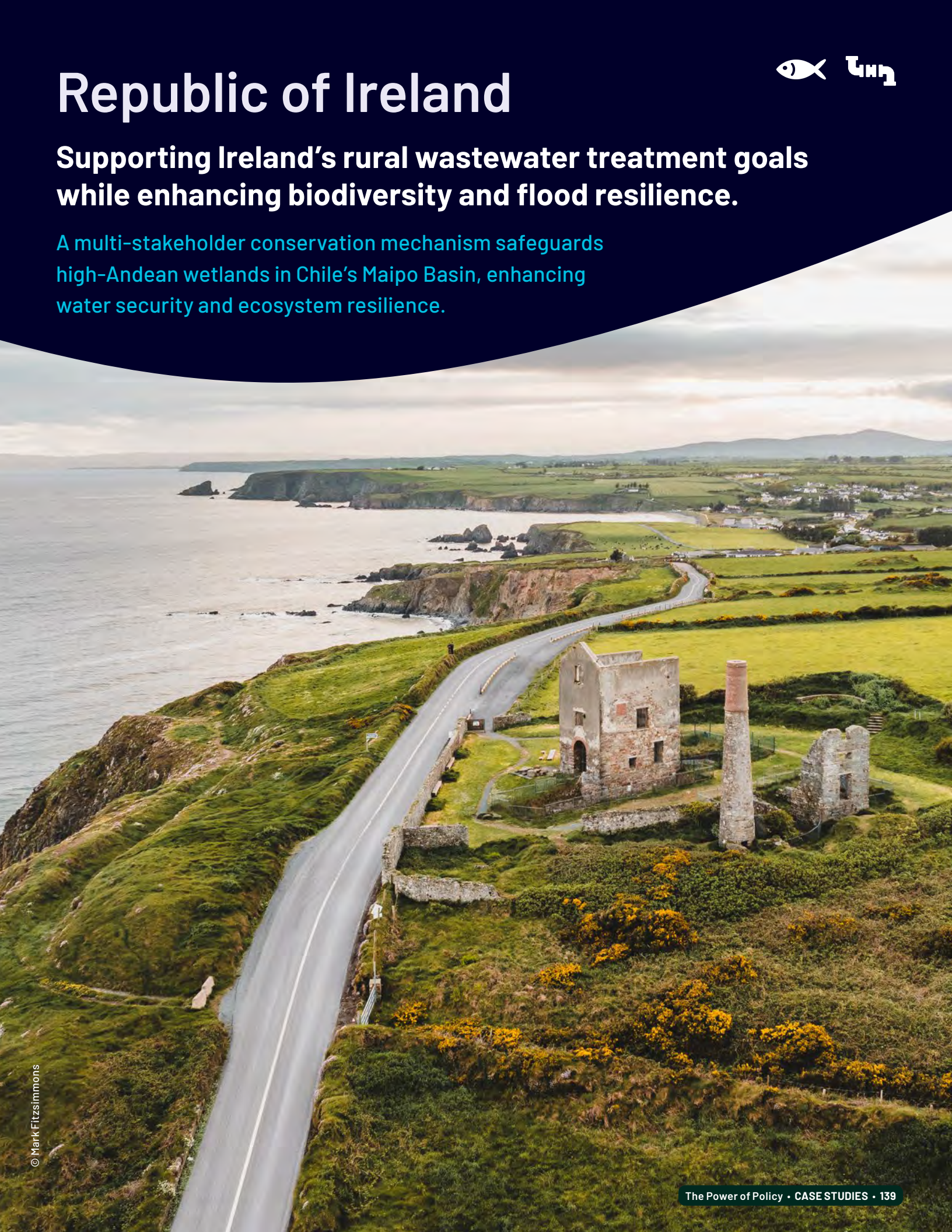
138 Congreso de la República del Perú. (2014). Ley de Mecanismos de Retribución por Servicios Ecosistémicos, Ley N.º 30215. Diario Oficial El Peruano. https://www.gob.pe/institucion/minam/normas-legales/3580-30215.

139 Cerdan, G., Camarena, G., & The Mountain Institute. (2023). Nature-Based Solutions and their Socio-Economic Benefits for Peru. Oxford Biodiversity Network. https://www.biodiversity.ox.ac.uk/research_stories/generating-evidence-to-foster-nature-based-solutions-in-peru.

Republic of Ireland

Supporting Ireland's rural wastewater treatment goals while enhancing biodiversity and flood resilience.

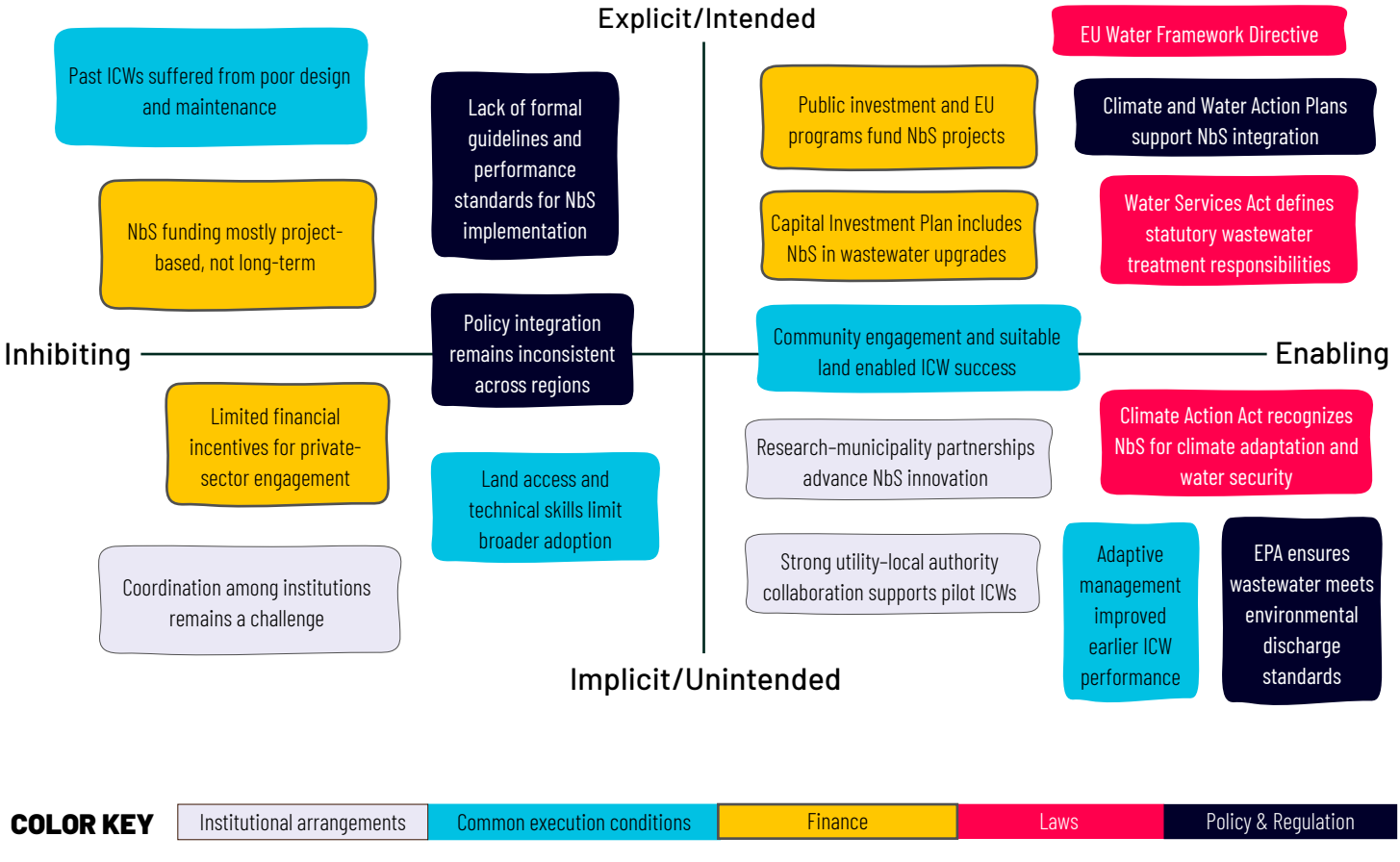
A multi-stakeholder conservation mechanism safeguards high-Andean wetlands in Chile's Maipo Basin, enhancing water security and ecosystem resilience.



Context

Water Security: While Ireland is not a water-stressed country.[140] challenges related to water quality, aging infrastructure, and climate change impacts are increasing. Approximately 83% of the national water supply is sourced from surface water, while the remaining 17% relies on groundwater, which is highly susceptible to contamination, particularly in karstified limestone areas. Climate change is exacerbating these risks, leading to shifts in rainfall patterns, increased flooding, and extended dry periods that strain existing water management systems. Urbanization and agricultural runoff further contribute to declining water quality, necessitating innovative approaches to water security.

Water and Wastewater Management: Ireland's water governance is structured around Uisce Éireann, a state-owned water utility that manages public water services. The National Water Resources Plan[141] and the Water Services Strategic Plan[142] outline long-term investment strategies to improve infrastructure and meet EU water quality directives, with the Environmental Protection Agency (EPA) regulating water resource and water quality. Compliance with wastewater treatment standards set by the EPA remains a challenge, particularly in smaller settlements that lack adequate infrastructure.[143] Many rural communities still rely on outdated systems, leading to untreated wastewater discharges into receiving water bodies.[144]



140 National Water Resources Plan—Framework Plan: Irish Water's 25 Year Plan for Our Water Assets. (2021). Uisce Éireann. https://www.water.ie/sites/default/files/projects/strategic-plans/national-water-resources/2.-NWRP-Framework-Plan_For-Final-Adoption_2021_05_25.pdf.

141 Water Services Strategic Plan. (2023). Uisce Éireann. https://www.water.ie/projects/strategic-plans/water-services-strategic.

142 Urban Wastewater Treatment in 2023. (2023). Environmental Protection Agency, Ireland. https://www.epa.ie/publications/monitoring—assessment/waste-water/Urban-Wastewater-Treatment-in-2023-report.pdf.

143 Regional Water Resources Plan South East. (2023). Uisce Éireann (Irish Water). https://www.water.ie/sites/default/files/docs/projects/strategic-plans/national-water-resources/rwrp/2023/Regional-Water-Resources-Plan-South-East.pdf.

144 EPA reference A0379-01. (2011). https://epawebapp.epa.ie/licences/lic_eDMS/090151b2803e3158.pdf.

Factsheet Summary	
Main facilitator	Uisce Éireann Waterford City and Waterford County Council Vesi Environmental Dunhill Village Local Farmers
Primary Water Objective	Wastewater discharge quality
Catchment/watershed management or 'End-of-pipe'	Utility or service provider operations/network/infrastructure (e.g., "End-of-pipe")
NbS Category 0.01"	Artificial habitats
Co-benefits	Flood management, Biodiversity, Amenity
Solution adopted at scale?	No, but increasingly integrated into national wastewater treatment strategies

The Case Study

The Dunhill Integrated Constructed Wetland (ICW) in Waterford County serves as a successful example of nature-based wastewater treatment.[145] Established in 1999, the ICW was initially designed for a population of around 200 but has since expanded to accommodate up to 500 residents. It provides an effective and low-maintenance alternative to conventional wastewater treatment plants by using natural wetland processes to remove pollutants. The system also delivers co-benefits such as flood mitigation, enhanced biodiversity, and recreational opportunities for the local community.

Relevance to National Context: The Dunhill ICW aligns with Ireland's commitment to meeting EU water quality directives and the objectives outlined in national water management strategies. The increasing recognition of NbS within policies such as the Climate Action Plan[146] and the Water Action Plan[147] reflects the country's shift toward more sustainable water infrastructure. However, despite these advancements, barriers such as the lack of a national water abstraction register and standardized guidelines for NbS implementation persist, limiting the broader adoption of similar solutions.

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145 Climate Action Plan 2024. (2025). Government of Ireland. https://www.gov.ie/en/publication/79659-climate-action-plan-2024/.

146 River Basin Management Plan 2022-2027. (2024). Government of Ireland. https://www.gov.ie/en/policy-information/8da54-river-basin-management-plan-2022-2027/.

147 Water Services Act 2013. (2013). Electronic Irish Statute Book. https://www.irishstatutebook.ie/eli/2013/act/6/enacted/en/html.

Enabling Conditions

Law: Ireland's legal framework for water management is guided by EU directives and national policies. The Water Services Act (2013)[148] defines statutory responsibilities for wastewater treatment. The Climate Action and Low Carbon Development Act (2021)[149] formally acknowledges NbS as a viable approach to climate adaptation and water security.

Policy and Regulation: While NbS are increasingly recognized in Irish policy frameworks, their integration into regulatory mechanisms remains inconsistent. The EPA focuses on ensuring that wastewater discharge meets environmental quality standards. However, the absence of clear NbS guidelines results in variability in implementation across different regions. Strengthening regulatory coherence and establishing formal standards for NbS performance monitoring would enhance their adoption at scale.

Funding and Finance: The financing of NbS projects in Ireland relies primarily on public investment, supplemented by EU funding programs such as LIFE and Horizon Europe. Uisce Éireann's Capital Investment Plan (2020–2024)[150] allocated significant resources to improving wastewater treatment, with a growing focus on integrating NbS where feasible. The Climate Action Fund and various local government initiatives also provide financial support for nature-based infrastructure projects.

Institutional Arrangements: Water governance in Ireland involves national agencies, local authorities, and community organizations among other actors. Uisce Éireann is responsible for wastewater treatment infrastructure, while the EPA oversees wastewater permitting and compliance with water quality standards. Collaboration between utilities, research institutions, and municipal planners has been instrumental in advancing NbS implementation, but coordination challenges persist. Strengthening institutional partnerships and developing capacity-building programs for NbS practitioners would support more effective implementation.

Common Execution Conditions: The successful implementation of ICWs in Ireland has been influenced by site-specific conditions (i.e., land ownership, land availability, soil conditions, etc.), community engagement, and regulatory support. However, challenges such as land availability, technical expertise, and public awareness still hinder widespread adoption. Some earlier ICW projects faced operational difficulties due to suboptimal design and maintenance issues, highlighting the need for continued research and adaptive management strategies. Enhancing technical capacity within Uisce Éireann and local authorities, along with developing standardized guidelines for ICW design and monitoring, would address these barriers and facilitate broader uptake.

148 Climate Action and Low Carbon Development (Amendment) Act 2021. (2021). Electronic Irish Statute Book. https://www.irishstatutebook.ie/eli/2021/act/32/enacted/en/html.

149 Capital Investment Plan 2020-2024. (n.d.). Uisce Eireann (Irish Water). https://www.water.ie/projects/strategic-plans/capital-investment-plan.

150 Molloy, A., Collier, M.J., & Buckley, Y.M. (2024, February). Identification and assessment of best practice in nature-based solutions for climate action and ecosystem restoration in Ireland. Trinity College, Dublin, School of Natural Sciences. https://www.climatecouncil.ie/councilpublications/councilworkingpaperseries/Identification%20and%20assessment%20of%20best%20practice%20in%20nature-based%20solutions%20for%20web.pdf.

South Africa

Nature-based Solutions as a cost-effective option for water security for the greater Cape Town region

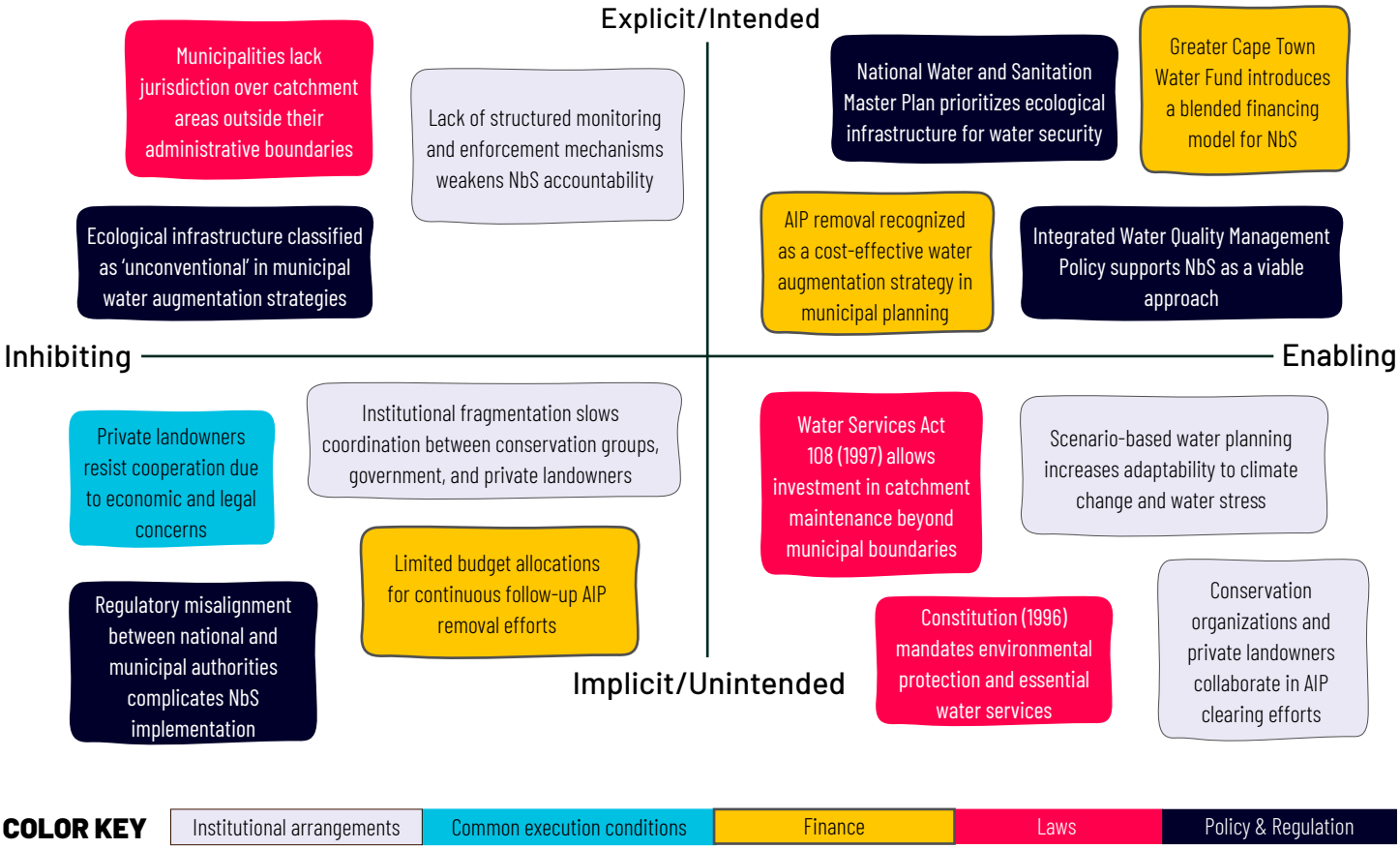
The removal of alien invasive plants (AIPs) restoring water availability while protecting biodiversity and reducing fire risks.

© Roshni Lodhia

Context

Water Security: South Africa faces significant water security challenges due to low and highly variable rainfall, high evaporation rates, and increasing demand from urban growth, agriculture, and industry. The country's average annual rainfall of 450mm is far below the global average of 860mm, with highly uneven distribution across regions.[151] Cape Town, in particular, has experienced severe droughts, including the 2015–2018 crisis, which nearly resulted in the city running out of water. The need for effective water management strategies has become increasingly urgent as climate change exacerbates extreme weather patterns, putting further strain on available water resources.[152]

Water Resources Management: The City of Cape Town relies on the Western Cape Water Supply System (WCWSS), an interconnected network of dams, aquifers, and pipelines serving both municipal and agricultural users.[153] This system is under growing pressure due to increasing population demand and climate variability. Conventional grey solutions, such as desalination and groundwater abstraction, have high costs and long lead times.



COLOR KEY Institutional arrangements | Common execution conditions | Finance | Laws | Policy & Regulation

151 King, J., Mitchell, S., & Pienaar, H. (2011). Water supply and demand In Sustainable use of South Africa's inland waters. Water Research Commission. https://www.wrc.org.za/wp-content/uploads/mdocs/TT%20491-11.pdf.

152 Western Cape Sustainable Water Management Plan 2017–2022: Towards a new norm for water resilience. (2018). Department of Environment and Development Planning (DEA&DP). Western Cape Government.

153 Our Shared Water Future: Cape Town's Water Strategy. (2020). City of Cape Town. https://resource.capetown.gov.za/documentcentre/Documents/City%20strategies,%20plans%20and%20frameworks/Cape%20Town%20Water%20Strategy.pdf.

Factsheet Summary	
Main facilitator	The Nature Conservancy City of Cape Town
Primary Water Objective	Water resource quantity
Catchment/watershed management or 'End-of-pipe'	Catchment/watershed management
NbS Category	Habitat protection, Habitat restoration, Land management
Co-benefits	Biodiversity
Solution adopted at scale?	Yes

The Case Study

The Greater Cape Town Water Fund,[154] launched in partnership with conservation organizations and government agencies, is implementing large-scale AIP removal in critical water catchment areas. The most problematic AIPs, including Australian acacia, pine, and eucalyptus, consume significantly more water than native fynbos vegetation, reducing both surface runoff and groundwater recharge. These invasive species can use up to 20% more water than native plants and contribute to severe wildfires, increasing soil erosion and degrading water quality. By systematically clearing AIPs from priority sub-catchments, this NbS approach is improving water yield while reducing fire risk and enhancing biodiversity conservation.

© Roshi Lodhia

Relevance to National Context: AIP removal aligns with South Africa's broader water security strategies, including the National Water and Sanitation Master Plan,[155] which identifies ecological infrastructure maintenance as a key action for closing the projected 17% water supply deficit by 2030. The City of Cape Town, like all municipalities in South Africa, has a constitutional responsibility to supply its residents with drinking water. In tandem with this responsibility is the duty to protect the environment. Collectively, these mandates provide the legal basis for the clearing of AIPs as the maintenance of "ecological infrastructure" to provide drinking water. Programs such as Working for Water have demonstrated the effectiveness of invasive species management over the past three decades. However, institutional barriers, funding constraints, and coordination challenges continue to hamper implementation.

154 Greater Cape Town Water Fund. Business Case. Assessing the Return on Investment for Ecological Infrastructure Restoration. (2019). The Nature Conservancy (TNC), Cape Town, South Africa. https://www.nature.org/content/dam/tnc/nature/en/documents/GCTWF-Business-Case-April-2019.pdf.

155 National Water and Sanitation Master Plan. (2018). Department of Water and Sanitation (DWS). https://www.dws.gov.za/National%20Water%20and%20Sanitation%20Master%20Plan/.

Enabling Conditions

Law: The Constitution of the Republic of South Africa Act (1996,)[156] is the primary normative enabler legislation for NbS. It establishes various fundamental human rights that must be protected and fulfilled by the state and regulates the conduct of municipalities, including the supply of essential services. The National Water Act (1998) recognizes water as a public resource and mandates sustainable management practices. The National Environmental Management Act (1998)[157] and National Environmental Management: Biodiversity Act (2004)[158]explicitly require municipalities and landowners to control invasive species. The Water Services Act 108 (1997)[159] defines maintenance of "water services work" narrowly, but when read with the duties imposed on water services authorities, this is sufficiently wide to include ecological infrastructure maintenance. This allows for the investment in maintenance of source water catchments outside the City of Cape Town's jurisdiction. Despite these legal provisions, implementation challenges arise when municipalities lack jurisdiction over catchments beyond their boundaries. Inter-municipal agreements remain a bureaucratic hurdle, delaying AIP clearing efforts.

Policy and Regulation: South Africa's Integrated Water Quality Management Policy[160] and National Water and Sanitation Master Plan promote nature-based approaches for water security. However, regulatory misalignment between national and municipal authorities complicates implementation. The Municipal Structures Act 117 (1998)[161] restricts municipal action outside their jurisdiction, making inter-governmental cooperation essential for effective catchment management. Strengthening these regulatory mechanisms through clearer mandates for cross-jurisdiction boundary water resource management could accelerate NbS uptake.

Funding and Finance: The Greater Cape Town Water Fund introduced a blended financing model, combining public investment from the City of Cape Town with private sector, such as corporations, and local agricultural stakeholders. Additional funding comes from philanthropic organizations and corporations. However, long-term financial sustainability remains a challenge. The WCWSS is managed by both the City of Cape Town and DWS. The City of Cape Town conducts separate planning to the WCWSS.[162] The City of Cape Town integrates NbS into its options for the WCWSS as part of the City of Cape Town's scenario-planning approach in the context of uncertainty.[163] This scenario-based approach considered AIP removal as a low-cost intervention that can provide water as part of an adaptive and scalable activity. In comparison to some of the alternatives where infrastructure requires replacement at the end of its lifetime, catchment restoration improves water yield for as long as catchments are maintained and AIPs are kept at bay.

Institutional Arrangements: Water governance in South Africa involves institutions at national, regional, and municipal levels. The Department of Water and Sanitation (DWS) is ultimately responsible for ensuring that water as a resource is allocated equitably and used beneficially in the public interest, while promoting environmental values. There are no Provincial departments for water management. Establishment of Catchment Management Agency's (CMAs) have had multiple dimensions of challenges, in part as a response to the physical constraints of a highly modified water network[164] but also due to institutional management issues.[165,166,167] The primary role of CMAs is to oversee protection, use, development, conservation, management, and control of water resources. Its responsibilities include monitoring compliance of water users with the objectives of resource-directed measures. The City of Cape Town leads local

156 Constitution of the Republic of South Africa, 1996. (1996). South African Government. https://www.gov.za/documents/constitution/constitution-republic-south-africa-1996-04-feb-1997.

157 National Environmental Management Act 107 of 1998. (2023). Republic of South Africa. https://www.gov.za/documents/national-environmental-management-act.

158 National Environmental Management: Biodiversity Act 10 of 2004. (2023). Republic of South Africa. https://www.gov.za/documents/national-environmental-management-biodiversity-act-0.

159 Water Services Act 108 of 1997. (2005). Republic of South Africa. https://www.gov.za/documents/water-services-act.

160 Water Quality Management Policy. Draft for public comment. (n.d.) Department of Water and Sanitation (DWS), Chief Directorate: Policy. https://www.dws.gov.za/Projects/Water%20Quality%20Management%20Policy/#:~:text=Public%20participation%20is%20a%20crucial,ensure%20active%20and%20engaged%20citizenry.

161 Local Government: Municipal Structures Act 117 of 1998. (2022). Republic of South Africa. https://www.gov.za/documents/local-government-municipal-structures-act.

162 Cape Town Water Outlook – 2024 – Edition 11. (2024). City of Cape Town, Bulk Water Branch, Bulk Services Department, Water & Sanitation Directorate.

163 The Economic Implications of Water Resources Management in the Western Cape Water Supply System. (2022). World Bank. https://documents1.worldbank.org/curated/en/099100002272330999/pdf/P17148306acd480fc0bfb504b0df294bfe8.pdf.

164 Bourblanc, M., & Blanchon, D. (2014, November 27.) The challenges of rescaling South African water resources management: Catchment Management Agencies and interbasin transfers. Journal of Hydrology. 519 (2381-2391. https://www.sciencedirect.com/science/article/abs/pii/S0022169413005714.

165 Gorgens, A., Pegram, G., Uys, M., Grobicki, A., Loots, L., Tanner, A., & Bengu, R. (1998). Guidelines for Catchment Management to Achieve Integrated Water Resources Management in South Africa, Pretoria. Water Research Commission (WRC Report KV 108/98). https://www.wrc.org.za/wp-content/uploads/mdocs/KV-108-98.pdf.

166 Pegram, G., & Palmer, I. (2001). Guidelines for Financing Catchment Management Agencies in South Africa, Pretoria. Water Research Commission, Report No.1044/1/01. https://www.wrc.org.za/wp-content/uploads/mdocs/1044-1-011.pdf.

167 Pollard, S., & Du Toit, D. (2008). Integrated water resource management in complex systems: how the catchment management strategies seek to achieve sustainability and equity in water resources in South Africa. Water SA 34 (6), 671–680 (IWRM Special Edition). https://www.researchgate.net/publication/290038309_Integrated_water_resource_management_in_complex_systems_How_the_catchment_management_strategies_seek_to_achieve_sustainability_and_equity_in_water_resources_in_South_Africa.

water planning but lacks direct control over catchment areas supplying its reservoirs. Partnerships with conservation organizations and private landowners have been essential in coordinating AIP removal across jurisdictional boundaries.

Common Execution Conditions: Implementing large-scale AIP removal presents logistical and institutional challenges. One of the primary barriers for long-term maintenance is the lack of investment by government in catchment restoration and management. The Working for Water program has provided an operational model for AIP clearing,[168] but ensuring consistent follow-up maintenance remains a critical challenge. Without regular re-clearing, invasive species quickly re-establish, negating initial water savings. Monitoring frameworks and digital decision support tools are helping to enhance project accountability and efficiency and to build trust with various stakeholders.

168 Van Wilgen, B.W., & Wannenburgh, A. (2016, April). Co-facilitating invasive species control, water conservation and poverty relief: achievements and challenges in South Africa's Working for Water Programme. Current Opinion in Environmental Sustainability 19: 7-17. https://www.sciencedirect.com/science/article/abs/pii/S1877343515000962.

Spain

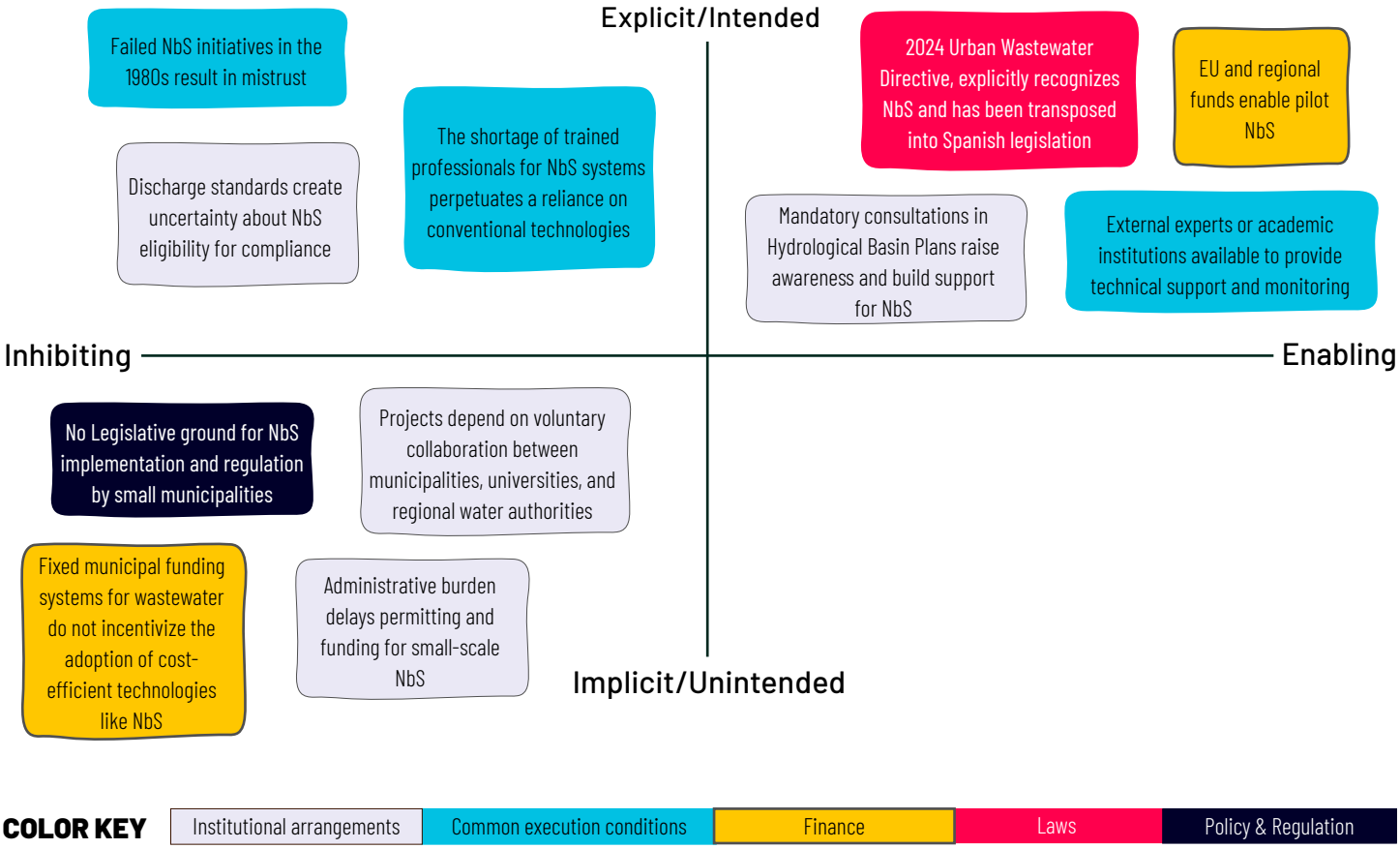
Constructed wetlands for wastewater treatment systems in small communities

The push for enhanced wastewater treatment in a small town as a driver for NbS development.

Context

Water Security: Spain is experiencing a decrease in water availability per capita, and its water security is declining at a more rapid rate than that of any other European country. Climate change impact is exacerbated by rising demand, and unsustainable management.[169] This includes overexploitation—especially in agriculture that depletes reserves, while low water tariffs discourage investment in sustainable infrastructure.

Water and Wastewater Management: Spain's decentralized water governance places wastewater treatment responsibilities on municipalities. While the EU Water Framework Directive[170] and Spanish national laws set treatment standards, they do not mandate specific technologies, allowing flexibility for NbS adoption. The 2024 revision of the Urban Wastewater Treatment Directive[171] extends regulatory requirements to smaller municipalities (more than 1,000 population equivalent), increasing pressure to implement effective solutions. However, many municipalities lack the technical and financial capacity to modernize their systems. As a result, many small towns treat less than 50% of their wastewater due to aging infrastructure and financial constraints, highlighting the urgent need for decentralized, cost-effective alternatives like NbS.[172]



169 Thirst for change: Accelerating progress to a water secure world. (2024). British Standards Institute (BSI), London. https://www.sciencedirect.com/science/article/abs/pii/S1877343515000962; https://www.bsigroup.com/en-US/insights-and-media/campaigns/thirst-for-change/.

170 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000, establishing a framework for Community action in the field of water policy (Water Framework Directive). Official Journal of the European Communities, L 327, 22 December 2000, pp. 1-73. Retrieved from Eur-Lex: https://eur-lex.europa.eu/eli/dir/2000/60/oj.

171 Directive (EU) 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment. (2024). Official Journal of the European Union. European Parliament and Council. Retrieved from Eur-Lex: http://data.europa.eu/eli/dir/2024/3019/oj.

172 Ortega de Miguel et al. (2010). Manual for the implementation of purification systems in small towns. Ministry of Environment and Rural and Marine Affairs. https://www.aragon.es/documents/20127/24009052/Manual+CEDEX2.pdf/32188fba-b20f-ecac-fb01-49a15e0e3cd9?t=1578648844927.

Factsheet Summary	
Main facilitator	Ministry for the Ecological Transition and the Demographic Challenge Public Entity for Wastewater Sanitation (EPSAR) Diputación de Valencia, the Research Institute of Water and Environmental Engineering (IIAMA) at the Polytechnic University of Valencia
Primary Water Objective	Water resources quality, Water resources quantity, Wastewater discharge quality, Receiving water body quality
Catchment/watershed management or 'End-of-pipe'	Utility or service provider operations/network/infrastructure (e.g., "End-of-pipe")
NbS Category	Habitat protection, Habitat restoration, Artificial habitats
Co-benefits	Biodiversity, Economic benefits, People-based co-benefits
Solution adopted at scale?	No, but growing interest and pilot projects underway

The Case Studies

Los Monasterios and Carrícola are two areas of the region of Valencia illustrating the viability of NbS for wastewater treatment for small groups of population in resource-constrained settings. Los Monasterios is a luxury residential area of 1,500 inhabitants, where a failing wastewater treatment plant was replaced by a system of four interconnected wetlands, enhancing pollutant removal and enabling water reuse for irrigation.[173] Supported by the LIFE RenaturWAT program, the project improved water quality and ecosystem health while integrating seamlessly into the landscape. Carrícola, a rural municipality of 150 inhabitants, implemented its first wastewater treatment system through a gravity-fed constructed wetland, reducing operational costs and improving biodiversity. Initially financed by the Valencia Provincial Council, later EU support enhanced nutrient removal and ecosystem restoration.

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Relevance to National Context: Spain's evolving regulatory landscape presents an opportunity to scale up NbS adoption. The 2024 Urban Wastewater Directive explicitly recognizes NbS,[174] while national initiatives like the DSEAR plan[175] promote innovative treatment for small municipalities. NbS offer multifunctional benefits—enhancing water treatment, retention, and reuse while restoring ecosystems and supporting biodiversity. In water-scarce regions, NbS can regenerate water for secondary uses, reducing dependence on other sources. However, regulatory uncertainty, a lack of technical guidelines, and financial barriers hinder widespread adoption.

173 Hernández-Crespo, et al. (2023). Valle Residencial Los Monasterios, an example of comprehensive management with nature-based solutions. TecnoAqua, 64. articulo-tecnico-valle-residencial-monasterios-ejemplo-gestion-integral-soluciones-naturaleza-tecnoaqua-es.pdf.

174 Directive (EU) 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment. (2024). European Parliament and Council. Official Journal of the European Union. Retrieved from Eur-Lex: http://data.europa.eu/eli/dir/2024/3019/oj.

175 Order TED/801/2021 of 14 July 2021, approving the National Plan for Purification, Sanitation, Efficiency, Saving and Reuse (Plan DSEAR). Boletín Oficial del Estado, No. 178, 27 July 2021, pp. 90608–90615. Retrieved from: https://www.boe.es/diario_boe/txt.php?id=BOE-A-2021-12592.

Enabling Conditions

Legislative Framework: Spain's legal framework implicitly allows for NbS in wastewater treatment but does not set ground for specific regulations that would facilitate their widespread adoption. The Water Framework Directive[176] and the revised 2024 Urban Wastewater Directive[177] establish environmental standards for treatment that are achievable by NbS, yet municipalities lack clear compliance guidelines. Royal Decrees 665/2023[178] and 1085/2024[179] mention that NbS can be used in urban drainage and water reuse, but historical reliance on conventional grey solutions and limited financial incentives continue to hinder investment.

Policy and Regulation: Bureaucratic complexity, lengthy permitting processes, and fragmented land ownership slow implementation of NbS, while the absence of standardized regulations creates uncertainty for municipalities and service providers. Spain's wastewater regulations set discharge limits but do not mandate specific treatment technologies, theoretically allowing for NbS integration. While the revised 2024 Urban Wastewater Directive[180] recognizes NbS, regulatory uncertainty persists, as municipalities lack clear guidance on how these systems can meet specified discharge requirements. However, some regional authorities, such as the Júcar Hydrographic Confederation, are beginning to incorporate NbS into hydrological planning, The absence of specific legal provisions discourages investment, as municipalities fear financial penalties for non-compliance when adopting NbS. Both case studies highlight these challenges—Carrícola had to adjust its system to enhance nutrient removal, while Los Monasterios expanded its wetland network to meet reuse standards

Funding and Finance: Municipal wastewater treatment is funded through tariffs and fees, but artificially low pricing—maintained for political reasons—undermines financial sustainability, particularly for small municipalities. While NbS offer cost-effective alternatives, such as gravity-fed wetlands that reduce energy-intensive processes, current financial models fail to reflect long-term savings. Fixed transfers by the Public Entity for Wastewater Sanitation (EPSAR) do not differentiate by technology, reducing incentives for municipalities to choose sustainable options. Without mainstreamed finance, Spain's primary NbS funding sources include European programs (LIFE, ERDF, Cohesion Fund) and national initiatives (DSEAR). However, access is limited by administrative hurdles and a lack of dedicated NbS financing channels. Both case studies illustrate the importance of these external sources of funding in overcoming financial barriers. In Los Monasterios, EU funds were combined with community resources to enhance its wetland system, while Carrícola relied on provincial and EU financial support. However, existing funding mechanisms do not incentivize NbS' long-term operational savings, highlighting the need for financial models that reward cost-effective and sustainable solutions.

Institutional Arrangements: NbS projects in Spain involve public institutions, private sector actors, and research organizations (e.g., IIAMA and CENTA-AMAYA), but institutional reluctance remains a major barrier. While Los Monasterios and Carrícola benefited from strong collaboration between citizens, municipal governments, regional water authorities, and academic institutions, conventional wastewater technologies continue to dominate. In both cases, IIAMA (Polytechnic University of Valencia) provided technical support and monitoring. In Carrícola, community involvement strengthened trust and project sustainability, while in Los Monasterios, collaboration with Fundació Mediambiental and technical experts facilitated implementation. Strengthening municipal coordination and technical assistance could help overcome barriers. Municipal authorities often prioritize high-visibility infrastructure projects. Both case studies faced delays due to institutional reluctance, with EPSAR initially favoring grey technologies. Specific discharge limits also created technical uncertainties, particularly regarding nutrient removal. However, recent shifts—such as EPSAR integrating wetlands into tertiary treatment and increased support from the Júcar Hydrographic Confederation—indicate a slow but growing acceptance of NbS.

176 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive). (2000). European Parliament and Council. Official Journal of the European Communities, L 327, 22 December 2000, pp. 1–73. Retrieved from Eur-Lex: https://eur-lex.europa.eu/eli/dir/2000/60/oj.

177 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive). (2000). European Parliament and Council. Official Journal of the European Communities, L 327, 22 December 2000, pp. 1–73. Retrieved from Eur-Lex: https://eur-lex.europa.eu/eli/dir/2000/60/oj.

178 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive). (2000). European Parliament and Council. Official Journal of the European Communities, L 327, 22 December 2000, pp. 1–73. Retrieved from Eur-Lex: https://eur-lex.europa.eu/eli/dir/2000/60/oj.

179 Royal Decree 1085/2024 of 22 October 2024, approving the Regulation on Water Reuse and amending various Royal Decrees regulating water management. (2024). Boletín Oficial del Estado, No. 256, 23 October 2024, pp. 135409–135460. Retrieved from: https://www.boe.es/eli/es/rd/2024/10/22/1085.

180 Directive (EU) 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment. (2024). European Parliament and Council. Official Journal of the European Union. Retrieved from Eur-Lex: http://data.europa.eu/eli/dir/2024/3019/oj.

Common Execution Conditions: Despite growing research and pilot projects, historical skepticism—stemming from failed NbS initiatives in the 1980s—persists, with many stakeholders perceiving them as unreliable. Conventional grey wastewater treatment solutions remain dominant due to their familiarity, compact design, and financial incentives for construction companies. Weak political and public interest further limits policy support. Structural challenges—including land availability, competition from intensive technologies, and operator resistance—exacerbate implementation difficulties.[181] While NbS offer long-term cost savings, existing funding models fail to incentivize adoption, and municipalities often lack the technical capacity to integrate them. Addressing these barriers requires regulatory clarity, financial incentives, expanded training, and streamlined administrative processes. Despite these obstacles, growing institutional support, increased regulatory recognition, and demonstrable environmental benefits, such as improved water quality and biodiversity, suggest a gradual shift toward wider NbS adoption in Spain.

181 Garcia & Corzo. (2008). Wastewater Treatment with Constructed Wetlands. Practical Guide for the Design, Construction and Operation of Subsurface Flow Wetland Systems. Universitat Politècnica de Catalunya. https://upcommons.upc.edu/server/api/core/bitstreams/a11b4efe-36f7-4444-bdff-aa7b47ea3b33/content.

United States of America

Water Sharing for Ecosystem Restoration in the Colorado River Basin

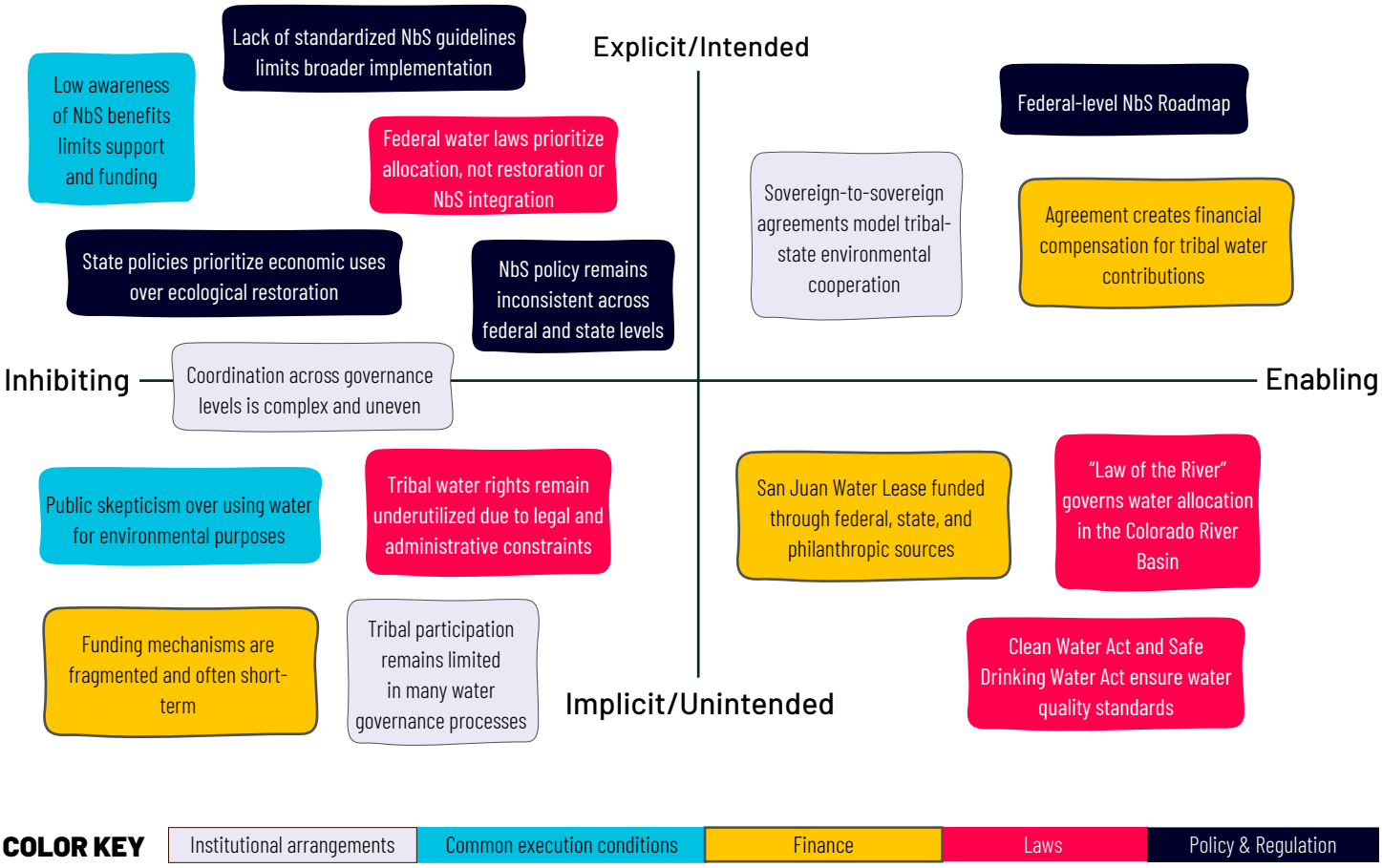
Securing water, restoring ecosystems and empowering Tribal Nations through sovereign-to-sovereign partnerships.

© Erika Nortemann/TNC

Context

Water Security: The United States faces diverse water security challenges, with water scarcity in the western states, aging infrastructure, and growing demand for industrial and agricultural water use.[182,183,184] The Colorado River Basin, a critical water source for more than 40 million people, has seen declining flows due to climate change, reduced snowpack, and increased evaporation.[185] The San Juan River, a tributary of the Colorado River, faces similar pressures, further exacerbated by pollution from historic mining activities and natural mineralization.[186]

Water Resources Management: Water governance in the United States is a complex, multi-tiered system involving federal, state, tribal, and local entities. The federal government sets national standards through agencies such as the Environmental Protection Agency (EPA) and manages, develops, and protects resources through others like the Bureau of Reclamation for water resources, while state governments grant, administer, and enforce water rights. Tribal nations have historically been marginalized in water governance,[187] despite holding significant water rights. The doctrine of prior appropriation governs water rights in many U.S. western states, which creates legal and administrative barriers for Native American communities to access and fully utilize their water allocations.



182 Buried No Longer – Confronting America's Water Infrastructure Challenge. (2012, October). American Water Works Association. https://www.awwa.org/wp-content/uploads/Buried-No-Longer-Report.pdf.

183 Bridging the gap: The economic benefits of investing in water. (2024). U.S. Water Alliance. Retrieved December 4, 2024, from https://uswateralliance.org/wp-content/uploads/2024/05/Bridging-the-Gap%E2%80%94The-Economic-Benefits-of-Investing-in-Water.pdf.

184 The future of water resilience in the U.S. (2024). ERM Sustainability Institute. Retrieved December 4, 2024, from https://www.erm.com/globalassets/sustainability.com/reports/the-future-of-water-resilience-in-the-us5.pdf.

185 Milly, P.C.D., & Dunne, K. A. (2020, February 20). Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation. Science 367,1252-1255(2020). https://www.science.org/doi/10.1126/science.aay9187.

186 How the watershed works. (2021). U.S. Environmental Protection Agency. Retrieved December 4, 2024, from https://www.epa.gov/system/files/documents/2021-09/session-1-how-the-watershed-works.pdf.

187 Aminzadeh, S., Willette, R. (2021.) Water Equity Taskforce: Insights for the Water Sector. US Water Alliance. Accessed December 4, 2024, from http://uswateralliance.org/sites/uswateralliance.org/files/FINAL%20Water%20Equity%20Taskforce%20Insights%20for%20the%20Water%20Sector.pdf.

Factsheet Summary	
Main facilitator	This is an agreement between TNC, the New Mexico Interstate Stream Commission, and the Jicarilla Apache Nation
Primary Water Objective	Water resources quantity
Catchment/watershed management or 'End-of-pipe'	Watershed/catchment management, Water resource management
NbS Category	Habitat restoration, Land management
Co-benefits	Biodiversity, Economic benefits, People-based co-benefits (enhanced decision-making, improved resource rights, spiritual and recreational value)
Solution adopted at scale?	No, but serves as a model for broader implementation in the Colorado River Basin

The Case Study

The San Juan Water Lease Agreement is a novel water-sharing initiative between the Jicarilla Apache Nation and the State of New Mexico. Under this agreement, the Nation leases up to 20,000 acre-feet[188] of water per year to the state, which is then released to support ecosystem restoration, endangered fish populations, and overall water security. The agreement provides financial compensation to the Nation while allowing New Mexico to test how it plans to meet its interstate water obligations. This collaborative model demonstrates how sovereign-to-sovereign partnerships can advance environmental restoration while supporting use of tribal water rights.

Relevance to National Context: The agreement aligns with national efforts to improve water resilience, particularly in the drought-prone western United States. Additionally, the agreement contributes to the San Juan River Basin Recovery Implementation Program, which aims to recover endangered fish species and improve habitat conditions. The model offers a replicable framework for other states and tribal nations seeking to balance water security with ecological conservation.

© Rory Doyle

188 Approximately 25,000 m^3.

Enabling Conditions

Law: The United States water governance is structured through federal laws such as the Clean Water Act (CWA)[189] and the Safe Drinking Water Act (SDWA),[190] which establish national water quality and safety standards. The Colorado River Basin is governed by a complex set of agreements, laws, and regulations known as the "Law of the River."[191] These include, among others, the Colorado River Compact, the Boulder Canyon Project Act, and the Colorado River Basin Project Act.[192] These frameworks primarily focus on water allocation and management across Mexico and the seven U.S, states of the basin.[193,194] Each state in the basin grants water rights and manages water according to state statute and rules.

Policy and Regulation: NbS integration in United States water policy remains inconsistent. While federal agencies promote sustainable water management, state-level regulations often prioritize water use for agriculture and industry, limiting opportunities for ecological restoration. Standardizing NbS guidelines and expanding state-level legal frameworks could enhance the adoption of water-sharing agreements for environmental restoration.

Funding and Finance: The San Juan Water Lease Agreement was funded through a mix of state and federal grants, with additional contributions from private and philanthropic sources.[195] Public funding mechanisms to support NbS initiatives such as water leasing are rare and often require complex application processes.[196,197,198]

Institutional Arrangements: Water governance in the United States is a complex, multi-tiered system involving federal, state, tribal, and local entities. The San Juan Water Lease Agreement is a sovereign-to-sovereign agreement between the Tribal Nation and state government, with support from TNC. This agreement demonstrates that increasing inclusion of Tribal Nations in water governance will improve outcomes for the entire Colorado River Basin.

Common Execution Conditions: Implementing NbS in the United States faces several challenges, including legal complexities, administrative barriers, and conflicting water use priorities. In addition, Tribal Nations still face obstacles to participation in collaborative and innovative solutions to the crisis in the Colorado River Basin due to program design limitations and unique qualities of their water rights. Additionally, public perception of water leasing for environmental purposes varies, with some stakeholders viewing it as a restriction on economic development. Addressing these barriers requires clearer legal pathways, increased funding for tribal water infrastructure, and expanded public engagement to build NbS programs that empower Tribal Nations to participate in solutions. At the same time, building awareness of NbS benefits allows for state and federal programs to fund NbS work generally.

189 Federal Water Pollution Control Act. (2017). U.S. Environmental Protection Agency. Retrieved from https://www.epa.gov/sites/default/files/2017-08/documents/federal-water-pollution-control-act-508full.pdf.

190 42 U.S.C. Chapter 6A - Public Health Service. (n.d.). Office of the Law Revision Counsel, U.S. House of Representatives. Retrieved from https://uscode.house.gov/view.xhtml?req=granuleid%3AUSC-prelim-title42-chapter6A-subchapter12&saved=%7CZ3JhbnVsZWlkOlVTQy1wcmVsaW0tdGlObGU0Mi1zZWN0aW9uMzAwZg%3D%3D%7C%7C%7C0%7Cfalse%7Cprelim&edition=prelim.

191 Management of the Colorado River: Water allocations, drought, and the federal role. (2024). Congressional Research Service. Retrieved December 4, 2024, from https://www.congress.gov/crs-product/R45546.

192 Management of the Colorado River: Water allocations, drought, and the federal role. (2024). Congressional Research Service. Retrieved December 4, 2024, from https://www.congress.gov/crs-product/R45546.

193 Colorado River management. (n.d.). Arizona Department of Water Resources. Retrieved December 4, 2024, from https://www.azwater.gov/crm/colorado-river-management.

194 Resources for the San Juan Watershed. (n.d.) U.S. Environmental Protection Agency. Retrieved December 4, 2024, from https://www.epa.gov/san-juan-watershed/resources-san-juan-watershed.

195 Aubrey, C., Patel, M., McElwain, T., & Robinson, C.S. (2024). Summary: Federal Permitting for Nature-Based Solutions. U.S. Army Corps of Engineers, Engineering With Nature Program. Retrieved from https://ewn.erdc.dren.mil/wp-content/uploads/2024/02/02-summary-federal-permitting-for-nbs.pdf.

196 Moskal, M. (2021, December 14). Infrastructure bill a win for Colorado land, water. Retrieved from https://coloradotu.org/blog/2021/12/infrastructure-bill-a-win-for-colorado-land-water.

197 What the Inflation Reduction Act means for water in the West. (2022, August 16). Audubon. Retrieved from https://www.audubon.org/news/what-inflation-reduction-act-means-water-west.

198 America the Beautiful Challenge: Frequently Asked Questions. (2022, July). National Fish and Wildlife Foundation. Retrieved from https://www.nfwf.org/sites/default/files/2022-07/atbc-faq-v2.pdf.

The Nature Conservancy