

Key Barriers to Advancing Climate Change Adaptation through Nature-based Solutions: Knowledge, Evidence and Capacity Gaps

Key Messages

- Gaps in interdisciplinary knowledge, evidence and technical capacity are major barriers that hinder nature-based solutions (NbS) for climate change adaptation from becoming mainstream. Knowledge on the best ways to implement NbS for climate change adaptation is often limited due to uncertainties in climate science that hamper assessments of effectiveness of all types of adaptation measures.
- To mainstream NbS for climate change adaptation, it is critical for the teams involved to make use of context-specific knowledge, knowledge held by Indigenous Peoples and scientific knowledge. It is also crucial for sustained investment to be established that builds and maintains capacity for NbS implementation and management over the long term.
- The interdisciplinary nature of NbS, the long timescales needed to observe NbS outcomes and the lack of robust metrics limit the supply and accessibility of data and evidence.
- Technical capacity gaps, including limited skills, the absence of locally tailored NbS approaches and a lack of tools for monitoring, evaluation and learning (MEL) create significant barriers to effective implementation of NbS for climate change adaptation. This is exacerbated by limited access to technology for NbS project developers.

Introduction

Nature-based solutions (NbS) have historically not been much considered as options for adapting to climate change. This is unfortunate because they can be very effective at reducing the threats presented by climate change like flooding, erosion and drought. In addition to enhancing people's climate resilience, NbS can also deliver a range of co-benefits, including restored and enhanced ecosystems and improved livelihoods for local communities. Valuable as they are, significant gaps in knowledge and capacity remain that hinder

effective design implementation and monitoring of NbS for climate change adaptation. One important knowledge gap is on what determines how effectively NbS can contribute to adaptation in different local contexts over what time frames. There are also gaps in knowledge of best practices for improving their effectiveness and in capacity to implement such practices. Quantitative assessments of the full range of benefits NbS provide under different circumstances are another knowledge gap. Such knowledge and capacity gaps are slowing the integration of NbS into climate adaptation strategies and action.

This brief identifies the most critically important knowledge and capacity gaps that are constraining the implementation of NbS for climate change adaptation, particularly in developing countries. It also outlines the impacts of these gaps and highlights some existing resources that can help address them.

Knowledge and capacity gaps

Although the concept of NbS has been defined and formalized relatively recently in multilateral environmental agreements, it builds on extensive experience of working with nature to address societal challenges. Nevertheless, knowledge gaps significantly impede the mainstreaming of NbS for climate change adaptation. Scientific evidence that can guide design and implementation of NbS for climate change adaptation is limited. This is especially true in developing countries, where there is great potential for them to be implemented. This pattern is exemplified by a recent global analysis of 546 case studies of NbS that reduced natural hazards, which found 60% were situated in Europe.¹

NbS often operate across multiple spatial, temporal and governance scales. This makes it complicated to design, implement and monitor them. These challenges combine with uncertainty in climate change projections and research gaps to limit the availability and strength of evidence around NbS.

Lack of technical and institutional capacity is another pervasive barrier to climate change adaptation action. All 56 National Adaptation Plans (NAPs) submitted to UNFCCC by June 2024 referenced the need for capacity-building, and 67% of the Second Nationally Determined Contributions (NDCs) made capacity-building a condition for NDC implementation.²

Inadequate data and evidence. There are major gaps in data and evidence on the overall effectiveness of specific NbS for

climate change adaptation under different circumstances and how it relates to ecosystem function. Site-specific knowledge of constraints on and requirements for NbS use is also scarce, as is quantification of co-benefits derived from specific NbS interventions. The discourse around the cost of NbS is polarized. Supporters emphasize the cost-effectiveness of NbS. Critics warn of significant long-term maintenance costs compared to more traditional grey infrastructure like dams and canals. Systematic data on non-tangible and non-market benefits of NbS such as the cultural value of nature and ecosystems central to many traditions, are also limited. Even less is known about the experiences that developing countries are having with NbS. Part of the problem is that the frameworks that have been established to assess NbS effectiveness and benefits are lacking or under-used in these countries. Further complicating the situation is an absence of information on the diverse worldviews and values that structure the relationship between people and nature in places where NbS are implemented.

Limited Technical Capacity to Plan and Implement. A significant barrier to the effective use of NbS for climate change adaptation is a widespread shortage of trained professionals with the skills required to design, plan and implement these solutions. Professionals who can bridge multiple disciplines and interpret the potential contributions of NbS across sectors effectively are scarce. This limits the availability of those who can translate the full potential of NbS into practical and context specific interventions. The lack of sufficient resources to attract, train and retain the required professionals further aggravates this skills gap. ILO, IUCN and UNEP (2024) reported that the majority of NbS employment is in developing countries and is characterized by part-time or limited-term project-based work.³ This highlights both the precarious nature of the work and the challenges of building long-term technical capacity.

Lack of appropriate monitoring, evaluation and learning (MEL) tools and capacity to use these tools. It is difficult to capture the full range of interconnected benefits that NbS for climate change adaptation can provide, and therefore to capture the full contribution of those NbS using conventional MEL approaches. Existing tools are often designed for static, short-term projects and are not well suited for evaluating multifaceted outcomes of NbS under continuously shifting climate risk. Adaptation outcomes are usually framed around a reduction in vulnerability, which is difficult to quantify, attribute and monitor. Attributing the role of nature in reducing vulnerability presents additional challenges. Moreover, few, existing frameworks support the robust and impartial assessment of current NbS over an extended period. Added to this challenge is the fact that resources for developing such frameworks and for building and maintaining capacity to sustain monitoring over the long term are severely limited.

Limited access to and application of technology. Digital technology could in principle make a key contribution to planning and implementing NbS for climate change adaptation efforts. However, tools are scarce that integrate technology and computational power to access geospatial data for modelling, simulation and data collection in ways that can support NbS for climate change adaptation. Global knowledge networks are not accessible to people working in the field. There is also a notable lack of both regional knowledge-sharing platforms and sophisticated modelling software necessary for NbS planning and design. The Adaptation Gap Report (2024) emphasized that technology transfer is central to capacity building for enhancing climate change adaptation action.⁴

Limited capacity to access and integrate indigenous knowledge. Indigenous Peoples and local communities possess centuries of observations and adaptive practices. They hold extensive traditional knowledge and a nuanced understanding of how local climates

and ecosystems operate. However, there are significant barriers that limit access to this knowledge. This prevents its use. This gap not only represents an enormous missed opportunity to more effectively wield NbS but also perpetuates a legacy of devaluing traditional wisdom.⁵

Gaps in technical knowledge, evidence and capacity result in limited understanding of the effectiveness and benefits of NbS for climate change adaptation and uncertainty regarding their outcomes. This in turn creates challenges in building a business case for using NbS for climate change adaptation. Such gaps can also mean that potential unintended consequences from NbS use in a given context remain unidentified and the associated risks cannot be mitigated.

These gaps therefore result in significant shortcomings across policy development, planning and practical implementation. They also contribute to difficulties in securing adequate financing for NbS in the context of climate change adaptation. Consequently, decision-makers often face challenges in prioritizing NbS over conventional engineered solutions. These difficulties are compounded by a limited capacity for interdisciplinary collaboration that reinforces institutional silos and further delays mainstreaming of NbS.

Existing and Potential Solutions

To address existing knowledge and capacity gaps and advance use of NbS for climate, collaborative, interdisciplinary and adequately funded initiatives are needed. These could build on existing tools and resources that help decision-makers to understand NbS. For example, a number of initiatives, such as the Global Program on NbS for Climate Resilience, the **Network Nature Knowledge Database**, and the **Oxford Nature-based Solutions Initiative** provide data reports, case studies and other resources relevant to NbS

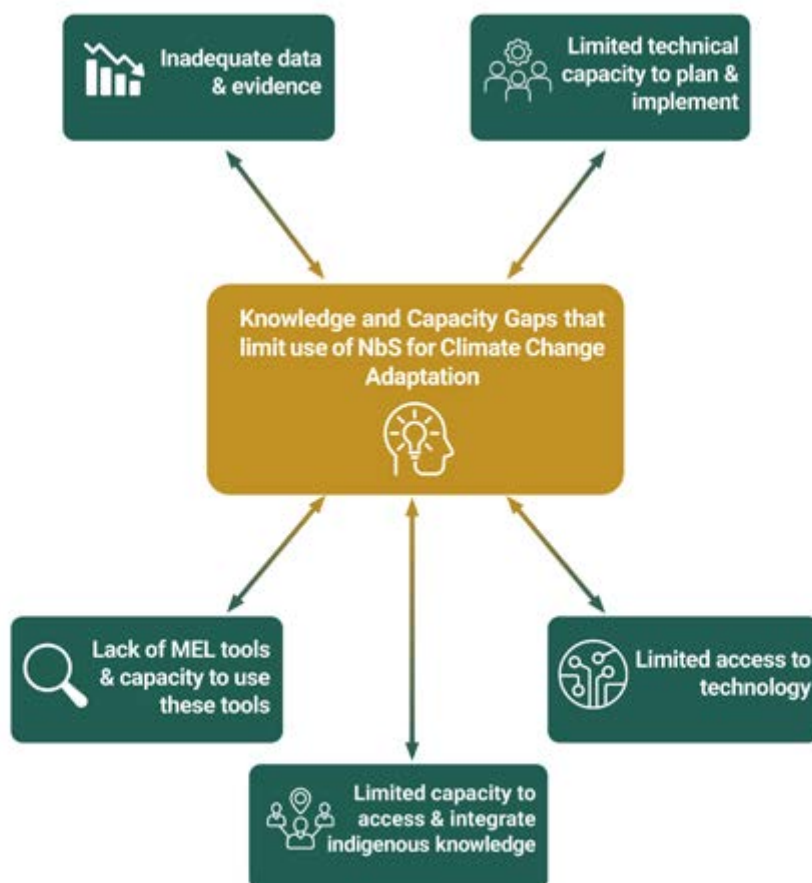
for climate change adaptation. Some online learning platforms specifically address the role of nature and NbS in climate change adaptation (e.g. UNEP's *Bringing Nature into National Adaptation Planning* and the IUCN Ecosystem-based Adaptation course). However, many existing resources are derived principally from experiences in developed countries and often do not adequately account for the unique ecosystems, local knowledge systems and socioeconomic realities of less-developed regions. Furthermore, many resources rely on rigid guidelines that constrain adaptive learning, ignore information on the local context and do not consider principles of justice, equity and rights – which are utterly essential for effective NbS implementation.

A key step forward is to engage with developing country decision-makers and other stakeholders to understand their experience of knowledge and capacity gaps relevant to their context and to develop solutions that fill those gaps and accelerate the use of NbS for climate change adaptation.

Conclusion

The critical knowledge and capacity gaps highlighted in this brief undermine the deployment of NbS for climate change adaptation and perpetuate fragmented governance. This is leading to continued reliance on conventional infrastructure that fails to deliver climate and biodiversity benefits. This pattern seriously jeopardizes the long-term resilience of communities, especially in developing countries that are severely affected by climate change.

To conclude, advancing NbS for climate change adaptation requires fostering knowledge through enhanced cross-sector collaboration and capacity building by integrating ecosystem dependencies, climate risk and vulnerability, and core NbS skills for professionals across relevant fields.



Key Guiding Questions

- What are the critical knowledge and capacity gaps that hinder effective planning, design, implementation, monitoring and upscaling of NbS for climate change adaptation in your context?
- How can knowledge and capacity gaps, identified above be addressed?
- How can local, regional and context-specific knowledge, including indigenous and scientific knowledge, be integrated to improve NbS implementation and scaling?
- What training and capacity-building initiatives are needed to enhance the skills of diverse stakeholders involved in NbS for climate change adaptation?
- What challenges exist in Monitoring, Evaluation and Learning and cross-sectoral collaboration for NbS, and how can these be addressed to support effective and integrated planning?

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