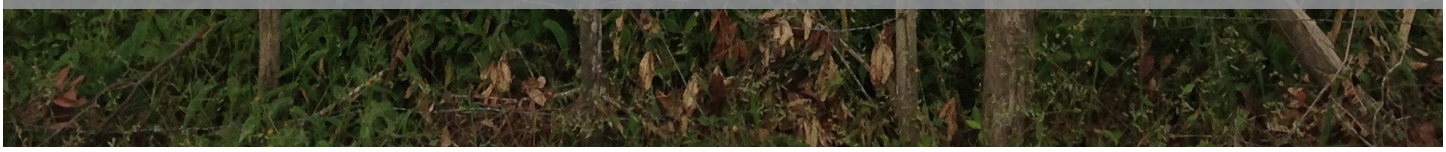
Northeastern University
School of Public Policy
and Urban Affairs

UNDP

Nature-based Solutions Valuation Report

Incorporating climate-informed cost-benefit analysis into assessment of Nature-based Solutions in Latin America and the Caribbean

June 2021



Executive Summary

As climate change disrupts local economies, ecosystems, and biodiversity in Latin America and the Caribbean, implementing effective solutions is paramount. Over the last decade, UNDP has worked with countries to deploy Nature-based Solutions (NbS) as an approach to meeting these multiple interconnected challenges while enhancing jobs and livelihoods and providing other socio-economic and ecosystem service benefits. NbS are strategies that use nature to meet environmental and social goals. There is growing momentum for the implementation of NbS, with governments and the UN calling for significant increases in investment in NbS to address the triple crises of climate change, biodiversity loss and poverty.

Despite the momentum behind NbS, investments are still low. Part of the challenge is a lack of evidence of the effectiveness and cost-effectiveness of NbS, which is essential to be able to make the business case for investments in NbS. UNEP's recent Adaptation Gap Report identified a lack of systemic data collection on NbS as a significant barrier to the scaling up of NbS. The portfolio of projects supported by UNDP has the potential to contribute to this needed evidence base. This report seeks to identify best practices for assessing this evidence and articulating the benefits (and costs) of NbS, both currently and under a changing climate.

The value of NbS can be difficult to assess due to the wide range of benefits and costs that extend beyond those that are easy to monetize or record. In addition, climate change impacts both the need for NbS and the effectiveness of these strategies, making the assessment of benefits and costs dynamic. Incorporating climate considerations into analysis of the benefits and costs of NbS is critical for climate-resilient long-term planning.

Numerous resources have been produced to support NbS cost-benefit analysis to enable more effective decision-making, data collection, analysis, and presentation of evidence for future investment in NbS. This report summarizes a scoping exercise that surveyed existing toolkits to support cost-benefit analysis of NbS and analyzed these toolkits to assess their appropriateness for meeting the needs of policy-makers, as well as climate change, ecosystems and biodiversity practitioners in the region.

The study analyzed 45 toolkits to identify best practices in cost-benefit analysis for NbS. We considered a resource to be a toolkit if it contained guidance on specific steps, tools or a process for either selecting NbS or assessing them. The approach to cost-benefit analysis, inclusion of benefits and costs, and incorporation of climate considerations was analyzed. We identified numerous toolkits with valuable guidance that may be relevant for UNDP-supported projects, and include case studies

of seven of these toolkits in the appendix. However, no single toolkit yet comprehensively provides guidance for cost-benefit analysis of NbS with a climate lens.

The study also examined evidence from 15 projects in UNDP's LAC portfolio to assess what data UNDP-supported projects are currently collecting on the benefits and costs of NbS. Our analysis found that projects are reporting a range of benefits of NbS, but there are important gaps in data collection which means the full value (and costs) of NbS are not being captured.

Based on this analysis, we conclude with a series of recommendations for a toolkit to support cost-benefit analysis of NbS with a climate lens. Critically, guidance should be directly contextualized to the LAC region with particular attention to the economic, ecosystem, and policy environment and feedback from project stakeholders. Attention to the long-term nature of NbS investments and the implications for cost-benefit analysis is also important (a key challenge for NbS is that the benefits can take several years to be fully realized compared to gray infrastructure solutions, requiring a long-term perspective). Incorporation of climate projections and guidance on the use of climate models is critical to ensure that NbS investments are climate-resilient.

This report and recommended guidance are intended to support NbS practitioners looking to identify the full range of social, economic, and environmental benefits and costs resulting from NbS. A credible, evidence-based foundation for assessing the benefits and costs of NbS can help to identify the most effective allocation of limited resources to address the drivers and consequences of climate change.

Table of Contents

Authors: Laura Kuhl, PhD and Alaina Boyle, Northeastern University
with contributions from Claudia Ortiz, Montserrat Xilotl, Simone Bauch, Santiago Carrizosa, Alexandra Fischer, and Radhika Dave, Regional Technical Advisors for Adaptation and Ecosystems and Biodiversity in UNDP

Photo credits: Laura Kuhl

FOR CITATION: Kuhl L. and Boyle A. "Nature-based Solutions Valuation Report: Incorporating climate-informed cost-benefit analysis into assessment of Nature-based Solutions in Latin America and the Caribbean" School of Public Policy and Urban Affairs, Northeastern University and United Nations Development Programme, June 2021.

Acknowledgements: *The authors gratefully acknowledge that this publication was funded by UNDP.*

The views expressed in this publication are those of the authors and do not necessarily represent those of the United Nations, including UNDP, or the UN Member States.

Introduction

Climate Change in Latin America and the Caribbean

Climate change poses significant challenges to the economic resilience of Latin America and the Caribbean (LAC). The region is especially vulnerable to climate impacts that are already disrupting agricultural production, ecosystem degradation, and causing human health issues. Temperatures are projected to increase up to one full degree Celsius by 2030 and precipitation is projected to decline, affecting freshwater availability and agricultural production and threatening food security and rural livelihoods.[1] Agriculture output will be impacted by increased temperatures, drought and rainfall variability, and pests and diseases, leading to reduced yields, higher variability in production, and impacts on food quality.[2]

Climate change will also contribute to increased extreme weather events, where the quantity of annual precipitation may remain the same but will be concentrated in short windows of time, causing flash floods that increase erosion and loss of assets. Increased hurricanes and other storms are also anticipated. Coastal regions and island nations are also vulnerable to sea level rise, storm surge, and salt water intrusion, impacting lives, resource-dependent livelihoods, and economic activity, including tourism.[4] Such changes to the climate will disrupt local economies and ecosystems, contributing to increased poverty and food insecurity, as well as economic losses at local and national scales across LAC.[3]

The Importance of Biodiversity in Latin America and the Caribbean

As acknowledged in a recent joint workshop by the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), there are many synergies between climate change and biodiversity and numerous opportunities to address these "dual crises" jointly.[5] LAC is an incredibly biodiverse region, home to more than 40% of remaining tropical forests,[6] 47 of the world's 258 marine eco-regions - more than any other region in the world,[7] and 11% of the world's agricultural land,[8] where 20.4 million farms are worked by over 14% of the region's population.[9] Protecting, conserving and restoring these resources is a key priority for the region.

Biodiversity is important not just in its own right, but also has significant economic and social value.

1. Magrin, Marengo, Boulanger, et al. 2014. Central and South America. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, Field, Dokken, et al. (eds.)]. Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA. pp. 1499-1566. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap27_FINAL.pdf

2. Kuhl L. 2018. Potential contributions of market-systems development initiatives for building climate resilience. World Development, 108, 131-144. doi.org/10.1016/j.worlddev.2018.02.036

3. World Economic Forum (WEF). 2019. *The Global Risks Report 2019* 14th Edition. World Economic Forum: Geneva. Retrieved from http://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf

4. Magin et al. 2014.

5. Pörtner, H.O., Scholes, R.J., Agard, J., et al.. 2021. IPBES-IPCC co-sponsored workshop report on biodiversity and climate change; IPBES and IPCC. DOI:10.5281/zenodo.4782538.

6. Poker and MacDicken. 2016. Tropical Forest Resources: Facts and Tables. *Tropical Forestry Handbook* pp 3-45. https://doi.org/10.1007/978-3-642-54601-3_7

7. ECLAC. 2020. The Outlook for Oceans, Seas and Marine Resources in Latin America and the Caribbean. https://www.cepal.org/sites/default/files/publication/files/46509/S2000911_en.pdf

8. FiBL. 2019. The World of Organic Agriculture. https://www.organic-world.net/yearbook/yearbook-2019.html

9. OECD and FAO. 2019. Chapter 2: Latin American Agriculture: Prospects and Challenges in *OECD-FAO Agricultural Outlook 2019-2028*. http://www.fao.org/3/CA4076EN/CA4076EN_Chapter2_Latin_American_Agriculture.pdf

As articulated in the recent Dasgupta Review on the Economics of Biodiversity, economies are embedded in nature, not separate from it; without nature there would be no economies.[10] Biodiversity supports economic, social and other policy goals. Biodiverse ecosystems can mitigate climate change by storing carbon, and can reduce the impacts of disasters due to flooding or soil erosion.[11] They are more likely to be resilient due to greater variety and adaptability of species,[12] and better provide services that support human and social needs such as food and water security, energy, medicine, and economic opportunities and inputs.[13] A recent analysis of terrestrial ecosystems in Latin America estimated the value of ecosystem services to be $15.3 trillion annually. The study also analyzed possible future scenarios, and concluded that the value of Latin America's terrestrial ecosystems could decline to $8 trillion per year or increase to $19 trillion per year by 2050, depending on what policy measures are put in place.[14]

This biodiversity is a tremendous resource for the region but is also being rapidly lost. LAC is estimated to have lost 75% of the genetic diversity of agricultural crops between 1910 and 2010.[15] Even more precipitously, between 1970 and 2006, animal populations decreased by 94% (over 20% higher than the global average decrease of 68%), primarily due to land use changes.[16] Biodiversity itself is vulnerable to both unsustainable human economic activity and climate change; a critical policy issue because biodiversity is essential to human, social, and ecological health. In LAC in particular, risks from climate change and biodiversity loss include water crises, natural disasters, food crises, conflict and involuntary migration.

Socio-economic Development and Green Recovery in Latin America and the Caribbean

Climate change and biodiversity loss are not the only challenges facing the region. The Covid-19 pandemic and its repercussions have demonstrated that the economy, supply chains, food systems, job markets, and livelihoods are extremely fragile. Covid-19 has caused a significant economic recession, with an average 7.7% drop in GDP from January to December 2020 in the region and growing inequality measured by a nearly 3% rise in the average Gini index in 2020 across LAC.[17] Regional unemployment rose to over 10% in 2020 and one third of LAC residents now live in poverty.[18] This trend was particularly harmful for women who predominately work in the service and informal sectors and have heavier family and home care responsibilities. Thirteen million women left the labor force between March 2020 and March 2021 due to the pandemic.[19] The Covid-19 pandemic

10. Dasgupta, P. 2021. The Economics of Biodiversity: The Dasgupta Review. London: HM Treasury.

11. UN CBD. 2010. Introduction. https://www.cbd.int/climate/intro.shtml

12. Oliver et al. 2015. Declining resilience of ecosystem functions under biodiversity loss. Nature Communications 6. https://www.nature.com/articles/ncomms10122

13. WHO. 2015. Biodiversity and Health. https://www.who.int/news-room/fact-sheets/detail/biodiversity-and-health

14. Hernández-Blanco, M., Costanza, R., Anderson, S., Kubiszewski, I. and Sutton, P., 2020. Future scenarios for the value of ecosystem services in Latin America and the Caribbean to 2050. Current Research in Environmental Sustainability, 2, p.100008

15. UNEP. 2010. State of Biodiversity in Latin America and the Caribbean. https://www.cbd.int/gbo/gbo3/doc/StateOfBiodiversity-LatinAmerica.pdf

16. WWF. 2020. Living Planet Report. https://livingplanet.panda.org/en-us/

17. CEPAL. 2021. Social Panorama of Latin America 2020. https://www.cepal.org/en/publications/46688-social-panorama-latin-america-2020. IMF. 2021. World Economic Outlook: Managing Divergent Recoveries. https://www.imf.org/en/Publications/WEO/Issues/2021/03/23/world-economic-outlook-april-2021

18. Ibid.

19. ILO. 2021. 13 million women in Latin America and the Caribbean saw their jobs disappear due to the COVID-19 pandemic. https://www.ilo.org/caribbean/newsroom/WCMS_775068/lang--en/index.htm

has revealed the vulnerability of market systems throughout the world, including throughout the LAC region. Economic shutdowns caused supply chain disruptions, impacting people's access to goods and services as well as the purchasing power of consumers. Even before the pandemic, the region faced significant development challenges, including ensuring inclusive growth and poverty reduction.

These crises have profound implications for economic growth, gender equity, and poverty reduction in the region, and demonstrate the importance of investing in resilience. These crises leave those who are already marginalized and on the brink of poverty in an even more vulnerable position, and place increasing pressure on already stretched public resources. Using economic stimulus policies to support investments that simultaneously address climate and environmental goals and economic recovery will lead to a more equitable, climate-resilient future for the region.

Nature-based Solutions

Nature-based Solutions (NbS) can help address climate, biodiversity and development challenges in an integrated fashion and are a critical tool for LAC. NbS are "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits."[20] NbS can be implemented for climate change adaptation and mitigation while also restoring ecosystems, conserving biodiversity and enabling sustainable livelihoods.[21] NbS can be implemented on their own or in conjunction with engineered approaches (known as hybrid approaches), depending on the specific needs and circumstances.

The concept of NbS encompasses other closely-related concepts, including ecosystem-based adaptation (EbA), which is defined as "the use of ecosystem management activities to increase the resilience and reduce the vulnerability of people and ecosystems to climate change."[22] NbS is a broader term than EbA, and incorporates the mitigation potential of natural solutions. One criticism of the term is that it can include solutions that use nature (for example, to sequester carbon and generate short-term benefits) but don't provide biodiversity or ecosystem benefits, undermining their value over the long-term.[23] It is very important when designing NbS to consider both short-term and long-term benefits and costs, and incorporate multiple goals into the analysis in order to ensure positive outcomes.

Figure 1, from UNEP's recent Adaptation Gap Report, illustrates ways that NbS can address climate hazards, while also providing additional benefits, particularly for biodiversity and development.[24] Due to their multiple benefits, NbS have the potential to cost-effectively achieve ecological, social,

20. IUCN 2021. https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions

21.UN Global Compact. 2021. Nature-Based Solutions to Address Climate Change. https://www.unglobalcompact.org/take-action/events/climate-action-summit-2019/nature-based-solutions.

22. United Nations Environment Programme.2021. Adaptation Gap Report 2020. Nairobi.

23. Ibid

24. United Nations Environment Programme.2021. Adaptation Gap Report 2020. Nairobi.

Figure 1. NbS can address climate hazards while also providing additional benefits

Hazard	NbS for adaptation	Potential additional benefits
 **Coastal hazards** • Sea level rise • Storm surge • Coastal erosion	• Mangrove protection and restoration to anchor sediments and dissipate wave energy • Management and restoration of coastal marshes and/or dunes to dissipate wave energy and/or complement engineered protection • Coral reef management and restoration to attenuate wave energy	• Improved fish stocks • Biodiversity conservation • Carbon sequestration and storage • Sediment accretion • Tourism and recreation and associated employment
 **Intense precipitation** • Flood • Soil erosion • Landslide	• Management and restoration of watershed vegetation to enhance infiltration, reduce run-off and peak flows, and stabilize slopes • Agroforestry to enhance canopy interception of rainfall and rainwater infiltration and reduce soil exposure, thereby reducing run-off and erosion • Urban watercourse restoration, and 're-naturing' to reduce assets at risk and secure riverbanks • Maintenance and restoration of urban greenspaces to improve rainwater infiltration and reduce run-off • Management and restoration of wetlands to store floodwater or slow its release and filter sediments	• Increased availability of wild-sourced food and other products • Pollination services • Carbon sequestration and storage • Improved soil fertility • Biodiversity conservation • Improved water quality • Improved physical and mental health among urban populations
 **Drought**	• Management and restoration of watershed vegetation to enhance infiltration, recharge groundwater stores and maintain surface water flows • Establishment of 'Green Belts' to increase water availability, improve soil quality, provide shade and windbreaks	• Increased availability of wild-sourced food and other products • Pollination services • Carbon sequestration and storage • Improved soil fertility • Biodiversity conservation
 **Rising temperatures** • Heat stress • Urban heat islands • Wildfire	• Agroforestry to enhance canopy cover and provide shade • Rehabilitation and restoration of rangelands to repair ecological processes and enhance fire resistance • Creation of urban green spaces to increase vegetative canopies, which provide shade and evaporative cooling	• Carbon sequestration and storage • Improved soil fertility • Biodiversity conservation • Improved physical and mental health among urban populations

and economic goals, although the cost-effectiveness and social desirability of NbS vary from one context to another. This is one of the key reasons why rigorous analysis of the benefits and costs of NbS is needed to inform decision-making. NbS have been described as helping build resilience in a way that provides "the most benefit for the least cost"[25] compared to gray infrastructure.[26] For example, NbS have been found to be 2-5 times more cost-effective than engineered structures for coastal flood and erosion management.[27] The cost-effectiveness is particularly high because they not only address climate risks, but also provide significant economic and social benefits including local disaster resilience, economic growth, health, gender empowerment, improved infrastructure, and other services for households and communities.

NbS do not only address climate change but also support development. One key benefit of NbS is that they can create jobs (formal employment in exchange for a wage or salary), new and more resilient livelihood opportunities, and increased incomes including for vulnerable households, improving the overall resilience of the economy and society. Livelihoods consist of the combination of activities and strategies pursued by household members, using their available assets (physical, natural, human, social, financial) to make a living, and can include formal jobs, but also self-employment and non-income generating subsistence strategies. NbS can generate new and expanded income opportunities through payment for ecosystem services schemes, in which participants are paid to maintain or restore ecosystem services, new livelihood opportunities, such as through agricultural product diversification, and job creation, such as in the ecotourism industry.[28] This is particularly important as governments plan social and economic recovery given the devastating impacts of the Covid-19 pandemic on jobs and livelihoods throughout LAC.

In a changing climate, NbS are likely to become even more important as interventions that can support regional, national, and international mitigation, adaptation, and development goals. A recent review of the evidence of NbS for climate adaptation found that 59% of NbS reduced climate impacts such as flooding, soil erosion and food production losses.[29] As Latin America and the Caribbean confront the interconnected crises of increasing rates of disasters, climate change, biodiversity loss, and unequal economic resilience with limited resources to address them, NbS offer a promising option that can synergistically achieve multiple objectives to improve well-being and empower communities.

Despite the many advantages of NbS, investments in NbS are still not widely implemented. UNEP's Adaptation Gap Report suggests that implementation of NbS grew strongly through the early 2020s,

25. Onuma and Tsuge. 2018. Comparing green infrastructure as ecosystem-based disaster risk reduction with gray infrastructure in terms of costs and benefits under uncertainty: A theoretical approach. *International Journal of Disaster Risk Reduction* 32: 22-28. https://doi.org/10.1016/j.ijdrr.2018.01.025

26. IUCN. 2016. Cost and Benefits of Ecosystem Based Adaptation: The Case of the Philippines. https://www.iucn.org/sites/dev/files/content/documents/philippines_cba_study_final_version.pdf

27. Narayan S, Beck MW, Reguero BG et al. 2016. The effectiveness, costs and coastal protection benefits of natural and nature-based defences. PloS one, 11(5). doi.org/10.1371/journal.pone.0154735

28. Boyle and Kuhl. 2021. Nature-based Solutions are Job and Livelihood Solutions. Policy Brief. School of Public Policy and Urban Affairs, Northeastern University and United 1\ Nations Development Programme. https://www.adaptation-undp.org/node/6650

29. Chausson, Turner, Seddon et al. 2020. Mapping the effectiveness of nature-based solutions for climate change adaptation. Global Change Biology. 26:6134-6155. doi.org/10.1111/gcb.15310

but that this growth may have slowed recently,[30] and assessments of economic recovery/stimulus spending globally, as well as throughout LAC, have found that finance has not gone to NbS, instead favoring traditional infrastructural investments.[31] There are several reasons for this, but one of the greatest challenges is the lack of consistent information and methodologies for evaluating the benefits of NbS as an adaptation and development strategy. Unless the benefits can be clearly articulated, it is difficult to make the business case for NbS. Many NbS have only recently been implemented, and so the evidence of their effectiveness, especially in addressing climate hazards, is still nascent.[32] Collecting data on the effectiveness of NbS among those investments that have been made is critical to building the evidence base for NbS. Additionally, climate change considerations are rarely incorporated into investment decisions. Identifying methodologies to assess the benefits and costs of NbS (and alternative) strategies under climate change is critical to be able to fully advocate for climate-resilient investments.

UNDP's Portfolio in LAC, Funded by Multilateral Environmental Funds and Bilateral Donors

For decades, UNDP has supported countries to access funds from the GEF, AF, GCF and bilateral donors in order to protect ecosystems and biodiversity as well as enhance climate-resilient livelihoods and management of natural resources in LAC, accumulating a wealth of case studies on the integration of climate and biodiversity action as alternative pathways for development and livelihoods that yield economic benefits. Ecotourism, carbon credits and biodiversity offset markets, sustainable agriculture, green commodities, resilient apiculture, and financial mechanisms such as payments for ecosystem services and compensation for conservation are all examples of livelihoods supported throughout this portfolio. These investments represent a rich opportunity to contribute to the evidence base on the value of NbS.

UNDP is committed to support countries as they build back better by investing in, amongst other things, NbS to protect and enhance ecosystems and vital biodiversity for long-term resilience; sustainable, resilient food and agricultural systems to address climate and planetary health; and diversified livelihoods.

Goals of the Report

This report responds to a call articulated in UNEP's Adaptation Gap Report for better evidence of the effectiveness and cost-effectiveness of NbS in order to support scaling up of implementation of NbS. Recognizing the importance of capturing environmental and socio-economic benefits of NbS, particularly benefits related to jobs and livelihoods, as well as the need to incorporate climate considerations, this report assesses current guidance for building the evidence base and making the economic case for NbS. The goals of this report are to a) survey existing toolkits to assess their coverage of benefits and costs related to NbS, b) identify best practices in cost-benefit analysis that

30. United Nations Environment Programme.2021. Adaptation Gap Report 2020. Nairobi.

31. Macquarie, R. B. N., Rosane, P., Solomon, M., Wetherbee, C. 2020. Updated view of the global landscape of climate finance 2019. Climate Policy Initiative, London, UK.

32.United Nations Environment Programme.2021. Adaptation Gap Report 2020. Nairobi.

include jobs and livelihoods and climate considerations, and c) assess the evidence emerging from current projects in UNDP's adaptation and biodiversity & ecosystems portfolios to identify alignments and make recommendations for next steps. This analysis was conducted as part of a scoping exercise for selected countries in the LAC region, with the goal of understanding the needs for tools to assess the economic case for NbS in practice in the region.

This report reviews existing toolkits and guidance to compare existing resources and identify best practices for assessing the benefits and costs of NbS. We focus on cost-benefit analysis as a critical tool to support advocates to make the business case for investing in NbS. We examine the extent to which existing toolkits guide cost-benefit analysis in practice and areas where new guidance may need to be developed to provide additional support to NbS practitioners and advocates as they identify project strengths, weaknesses, and target areas for future investment in a climate-constrained world. We screened toolkits for recurring major topics and theoretical foundations, including a systematic appraisal of the included costs and benefits, approaches to incorporating climate mitigation and adaptation, and data collection and analysis methodologies. In addition to surveying existing toolkits, we include several case studies highlighting toolkits that feature especially useful guidance or noteworthy features such as detailed theoretical foundations or a comprehensive methodology review (included in the appendix).

We also reviewed data from projects supported by UNDP and compared them to the guidance provided by existing toolkits to identify areas of strength in UNDP's portfolio, as well as potential gaps in current data collection on the benefits and costs of NbS. Through a comparison of best practices in existing toolkits and data, we identify recommendations for the design of future cost-benefit analysis guidance and support resources tailored to the needs of UNDP.

Organization of the Report

In the following section, we discuss cost-benefit analysis for NbS and how this approach can help make the economic case for NbS, supporting advocacy, policymaking, and investment choices. We then contextualize NbS in LAC, including the growing interest in NbS and their alignment with international and national policy goals. Next, we review existing toolkits for assessing the costs and benefits of NbS, identifying the focus areas of the toolkits, and methods for contributing to cost-benefit analyses. We then compare the toolkits and the benefits and costs that they include with project data collected by projects supported by UNDP in the LAC region, to identify data gaps and areas of strength in data collection across the portfolio. This analysis informs recommendations for the development of future guidance tailored to the needs of policy-makers, as well as climate change, ecosystems and biodiversity practitioners in the region. The report concludes with a review of key findings, including the importance of climate modeling for planning NbS under climate change, and the value of cost-benefit analysis for policymaking. Case studies of seven particularly promising toolkits are included as an appendix.

Cost-Benefit Analysis for Nature-based Solutions

Cost-Benefit Analysis as a Tool for Policy and Project Design and Implementation

Identifying the most appropriate strategies to address climate change, biodiversity loss, and development requires careful consideration of the benefits and costs of different strategies. Economic, ecological, social, and political benefits and costs all need to be considered when designing policies and programs. Cost-benefit analysis is a critical tool for NbS policy and project design and implementation, providing feedback for stakeholders, project implementers, and organizational or governmental oversight on the project's benefits relative to its cost and facilitates decision-making. It can support the identification of synergies between climate and biodiversity goals and other goals, including economic development, disaster risk reduction, public health and social wellbeing, as well as potential trade-offs between different goals.

Cost-benefit analysis is the process of comparing the projected or estimated costs and benefits (or opportunities) associated with an project or policy to determine whether it makes sense from a business perspective. Broadly speaking, all the costs are calculated and compared to all the benefits. If the benefits outweigh the costs, the investment makes sense economically. Advantages of cost-benefit analysis are that it is data-driven and builds on evidence, it can simplify the decision-making process by reducing a complex system to a set of benefits and costs that can be easily compared (especially if monetary values are assigned to the costs and benefits), and it can help uncover hidden costs and benefits by supporting analysis of all costs and benefits.

Cost-benefit analysis can occur prior to project implementation, using expected costs and benefits based on the project's theory of change, modeled or predicted outcomes, and relevant data from previous projects to identify whether a project will have a net benefit for the target population and beyond. Cost-benefit analysis can also support project implementation. A comparison of the full range of an intervention's ecological, climate, economic, social, and any other positive and negative impacts provides a substantial evidence base that identifies what is and is not working in a project, and what positive outcomes of the project are greater than the costs, and therefore worthy of investment.

Cost-benefit analysis can also be completed after a project has been implemented to compare expected and real outcomes and provide evidence that can be used to assess future projects. This data helps practitioners and decision-makers to prioritize project components and goals while informing future project design. This kind of analysis can also help decision-makers compare different strategies and more holistically consider the full range of potential benefits and costs of an approach.

Benefits and Costs of NbS

In our analysis, we identify a range of social, economic, and environmental costs and benefits that commonly result from NbS initiatives (See Table 1), although the specific benefits and costs that are relevant are dependent on an intervention's context and objectives. Analyses of NbS have found that in some cases the additional benefits of NbS beyond the climate risk and environmental benefits can

even exceed the benefits for climate and the environment. Including these additional benefits can greatly increase the social acceptance and rates of uptake of NbS.[33]

Socio-economic benefits

One category of socio-economic benefits are the economic benefits to jobs, livelihoods, and income. These may consist of increases in income such as through payment for ecosystem service schemes, higher prices or volumes of product sales due to certification and increased market access, or higher wages in industries that benefit from NbS such as ecotourism. Additional non-monetary benefits include the creation of new and diversified job and livelihood opportunities, more resilient livelihood opportunities and agricultural production, and more, higher quality, and more stable job and livelihood opportunities for women, which can help to address gender inequalities.

NbS have many health and social benefits as well. Health benefits include improved nutrition, stemming from increased and diversified production, and increased nutritional quality stemming from NbS,[34] and the health benefits from improvements in air and water quality. While not monetary benefits, many studies analyze the losses to economic productivity due to poor health and nutrition, and by extension, the economic benefits of improvements in nutrition and health for economic productivity, poverty reduction, and resilience.[35]

A subcategory of health and social benefits of NbS are community well-being and cultural benefits, including restored or conserved natural beauty, opportunities for recreational activities, and incorporation of contextually-appropriate traditional ecological knowledge into NbS. Environmental governance and diplomacy components of NbS can also contribute to reducing inequities, greater participation of all relevant stakeholders, and increased socio-environmental cohesion.

Although it is difficult to capture the full value of these benefits, they may be assessed and incorporated into cost-benefit analysis using stakeholder feedback, household surveys, literature on the impacts of similar interventions, economic and market data, and/or modeling, in the form of raw quantitative or qualitative data, contextual narrative, or through conversion to monetized data.

Ecosystem services benefits

There are many potential ecosystem services benefits from NbS, depending on the NbS project's specific objectives.

Carbon sequestration is one of the most commonly-identified benefits associated with NbS. Carbon sequestration refers to the amount of carbon stored due to interventions such as forest restoration

33. United Nations Environment Programme.2021. Adaptation Gap Report 2020. Nairobi.

34. Stratton, Kuhl, Blesh. 2020. Ecological and Nutritional Functions of Agroecosystems as Indicators of Smallholder Resilience. *Frontiers in Sustainable Food Systems*, 4, 173. https://doi.org/10.3389/fsufs.2020.543914

35. Hallegatte. 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. World Bank Publications. https://openknowledge.worldbank.org/bitstream/handle/10986/22787/9781464806735.pdf?sequence=13&isAllowed=y

and tree planting. Many NbS have mitigation benefits, and identification of the amount of carbon sequestered or avoided carbon emissions through the NbS can be critical to international obligations for climate change, making it a particularly attractive benefit to include in a cost-benefit analysis. When quantified, carbon sequestration benefits can also open opportunities to access carbon markets to finance NbS.

Disaster risk reduction refers to reduction in disaster risk or improved disaster risk management due to NbS, including the development of early warning systems, flood mitigation, or soil erosion management. This is closely linked to water quality and infrastructure improvements, which include improved water quality, filtration, or irrigation efficiency through project activities. The disaster risk reduction benefits of NbS have been estimated to be much greater than traditional infrastructure benefits for disaster risk reduction. Capturing these benefits can make it easier to compare NbS to alternative strategies for disaster risk reduction.

NbS can have soil, pollination, habitat, and biodiversity benefits, through initiatives such as the promotion of sustainable agricultural practices, conservation of pollination corridors, and promotion of beekeeping, habitat conservation and restoration, as well as other activities leading to conserved, restored, or increased biodiversity.

Another benefit of NbS is micro-climate regulation: initiatives that improve shade, local temperature, or local fire management. Some NbS can generate energy, commodities, materials, non-timber forest products, and medicine production benefits, which together refer to the cultivation and production of resources for energy, commodities for sale, production input materials, and medication.

These benefits may build on each other; for example, restored biodiversity may include plants that have medicinal benefits, can be harvested and sold as commodities, or are production input materials. Many of these are not directly monetary or even quantitative, but similar to the socio-economic benefits, can be assessed through the approaches discussed above as well as remote sensing and environmental (e.g., Geographic Information System) data. While the full value of ecosystems can never be captured by calculating the monetary value of the ecosystem services they provide,[36] calculating the monetary value of the ecosystem services provided by NbS can help to make the economic case for NbS.

Costs

Beyond the direct financial costs of NbS that are presented in a project budget are other, more difficult to quantify costs. Opportunity costs include the costs of not implementing alternative approaches to the NbS project due to limited availability of funds or resources. For example, if there are resources to implement either a payment for ecosystem services scheme to enable agroforestry conservation and

36. Daily, Söderqvist, Aniyar. 2000. The Value of Nature and the Nature of Value. *Science*, 289(5478), 395-396. doi: 10.1126/science.289.5478.395

livelihoods while sequestering carbon or a watershed quality and disaster risk reduction initiative, the opportunity cost includes the benefits that are not gained from the strategy that is not implemented. Opportunity costs are not only about trade-offs between NbS, but require recognizing the opportunity costs of implementation of NbS in general. For example, there are real opportunity costs associated with participating in conservation activities, as opposed to, for example, clearing the forest, especially in the short-term. These costs are hard to estimate because they are a counterfactual, or an alternate reality where the NbS was not implemented, and therefore can be difficult to calculate or monetize. However, they need to be taken into account for any NbS to be successful and meet the needs of local people.

There are several methodologies for considering counterfactuals. The gold-standard is to conduct a RCT, or randomized controlled trial, which allows for the comparison of outcomes of an intervention (in this case the implementation of a NbS) to the outcomes in a comparable area that did not implement the NbS. However, RCTs are not always appropriate because of the high costs of implementation and data collection, and the challenges of identifying relevant comparison sites without interventions. Simulation models are another approach that can allow decision-makers to consider different alternative models. Sometimes a simple exercise to identify trade-offs is sufficient for decision-making.

Environmental costs include any negative environmental impacts or environmental degradation that results from project implementation, which may include pest control impacts, greenhouse gas emissions from construction materials, or ecosystem effects of the production of a new agricultural good. Environmental projects, are, of course, designed to minimize such costs and mitigate them where possible. At UNDP, all projects have to go through careful environmental (and social) safeguards screening before approval and implementation.

Finally, there are other potential costs that may include negative social costs, such as failure to incorporate diverse stakeholders and their needs in project design and implementation, access restrictions for local people due to strengthened protected areas management, or negative impacts on regional politics. These costs can be difficult to assess and integrate into cost-benefit analysis, especially if the NbS's effects extend beyond the geographical or temporal scope in which the project is implemented - a limitation that in some cases can be mitigated by soliciting stakeholder feedback and applying theoretical frameworks to understand how the project implementation activities lead to its costs and benefits.

Valuation and Cost-Benefit Analysis

Cost-benefit analysis can include both quantitative and qualitative assessments of benefits and costs, but for more quantitative approaches, valuation exercises can inform the analysis. Valuation is the process of converting all of the benefits and costs into financial figures. A benefit of converting

benefits and costs to monetary values is that it allows easy comparison across very diverse benefits and costs and can provide a single numeric value for the cost-effectiveness of an intervention. It also enables simple comparisons across different investment options.

A challenge to identifying the value of a NbS is that it is impossible to completely capture the NbS's full benefits or costs through a valuation exercise. Although project budget and increased incomes from NbS are relatively easily tracked, this does not mean that data on the monetary benefits from NbS are routinely gathered. The costs and benefits of NbS also extend beyond strictly monetary costs and benefits. By converting the benefits and costs into monetary figures, non-monetary benefits and costs may be obscured.[37] Qualitative benefits of NbS such as increased livelihood opportunities or improved flood resilience do not necessarily have directly monetized indicators. However, to fully assess the benefits compared to the costs of NbS, it is important to include the full range of project benefits and costs in cost-benefit analysis even if they are not monetized or even quantified, because these are still non-zero benefits that NbS provide, and therefore should not be accounted as having zero value by being excluded from the analysis.[38]

Another challenge is assessing when the full range of ecosystem services will materialize. Unlike built infrastructure, which is static, NbS are dynamic, and therefore the value of benefits can change over time. For example, for mangrove restoration, the full benefits are not realized until 5-7 years after the investment is made. As NbS mature, more benefits can be included and, as time passes, the value can increase dramatically. A sea wall may compare favorably to a NbS if only the current benefits are included, because the sea wall can begin providing protective services immediately, while a NbS requires time to provide these benefits.[39] However, both gray infrastructure and NbS are intended to be long-term investments, so it is appropriate to project the benefits out over time.

Careful consideration should be given to whether valuation exercises will help decision-making and how these analyses can be complemented by additional measures to ensure that the full benefits and costs are incorporated into decision-making. Sometimes simple alternative decision-support tools, such as comparative lists of costs and benefits, elicitations of priorities and preferences or feasibility studies may suffice and detailed monetary information may not be necessary.

Despite these challenges, valuation can be a useful tool at all stages of policy and project development. It can inform project design. Valuation can be used to assess proposed projects to identify whether they have a greater total benefit than cost and are therefore worth investment and implementation. It can also be used to compare potential proposed strategies and in policy and project implementation. Monetizing project benefits throughout implementation can help to assess

37. UNEP. 2020. The Economics of Nature-based Solutions: Current Status and Future Priorities. https://www.un.org/sites/un2.un.org/files/economics_of_nbs_0.pdf

38. Chausson, Turner, Seddon et al. 2020. Mapping the Effectiveness of Nature-based Solutions for Climate Change Adaptation. *Global Change Biology*. 26:6134-6155. doi.org/10.1111/gcb.15310

39. United Nations Environment Programme.2021. Adaptation Gap Report 2020. Nairobi.

an ongoing project and guide the remaining implementation. Finally, following project completion, valuation can be used to help identify the project's total benefit, help identify relationships between project activities and outcomes for future valuation, and inform future resource allocation.

Incorporating Climate Change into Cost-Benefit Analysis

Under climate change the need for NbS will increase. In many cases, the value of the ecosystem services will increase as the need for these services increases due to climate change. For example, the value of mangroves for flood protection is significantly higher if projections of increased flooding are incorporated into the analysis of benefits. Many studies estimate the value of ecosystem services, including climate adaptation services (see Table 2). However, climate projections and evolving scenarios for climate change have seldom been factored into cost-benefit analyses. Without incorporating ways that ecosystem services will be impacted by climate change into project design, these projects are not able to account for how the value and provision of environmental services will change due to changes in climate.[40]

At the same time, climate change will impact ecosystems, affecting ecosystem services and biodiversity and therefore the type and extent of NbS outcomes that can be produced based on those services. There are climate tipping points beyond which ecosystems are not able to provide the same ecosystem services. For example, coral reefs are predicted to not be able to survive more than 2 degrees C of warming, and above this threshold, their value as a NbS will decline dramatically.[41] These projections also need to be incorporated into cost-benefit analyses in order to avoid overly optimistic calculations of the long-term benefits of some NbS and short-term investments.

When climate projections and the consequent impacts on the benefits and costs of NbS are not incorporated into cost-benefit analyses, it leads to inaccurate accounting of the short and long-term value of the livelihood opportunities and development options identified, often in ways that discount the future value of NbS. Dynamic climate risks and projections therefore need to be incorporated into the cost-benefit analysis to decide whether to implement and how to design NbS. In the comparative analysis of existing toolkits, this topic is discussed in more detail.

40. Seddon, Chausson, Berry, et al. 2020. Understanding the Value and Limits of Nature-based Solutions to Climate Change and Other Global Challenges. *Philosophical Transactions of the Royal Society B*, 375(1794), 20190120. http://doi.org/10.1098/rstb.2019.0120

41. United Nations Environment Programme.2021. Adaptation Gap Report 2020. Nairobi.

Nature-based Solutions in Latin America and the Caribbean

Nature-based Solutions Rise on the International Policy Agenda

There is increased international understanding of the potential of NbS to address multiple global policy goals. The value of NbS to build ecosystem resilience and support biodiversity in ways that contribute to efforts to mitigate greenhouse gas emissions, adapt to current and projected future climate changes, and reduce vulnerability to extreme weather events has garnered policy support.[42] The 2015 Paris Agreement recognizes the importance of NbS, calling on parties to "note the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity," and the REDD+ mechanism explicitly supports NbS.[43] Most Nationally-Determined Contributions (NDCs) submitted to the Paris Agreement (106 out of 168) include ecosystem protection as a motivation for adaptation planning and include ecosystems in their discussion of adaptation needs and approaches.[44] A recent analysis estimated that over 90% of NDCs from Least Developed Countries (LDCs) included NbS for adaptation.[45]

NbS are also gaining prominence in the international biodiversity regime. The Dasgupta Review of the economics of biodiversity, as a high-level political synthesis of existing science, strongly argues that natural capacity, including ecosystem services and biodiversity, is an essential asset on which human life, livelihoods, and economies depend, that should therefore be valued and supported through widespread and large-scale investment in NbS.[46] The preliminary draft of the post-2020 Global Biodiversity Framework under the Convention on Biological Diversity (CBD) has recommended NbS as a cost-effective option to manage and restore biodiversity, enable environmental and economic progress toward the Sustainable Development Goals, and ignite transformational change in the relationship between people and nature.[47] NbS will stay at the forefront over the next decade of environmental policy as the UN Decade on Ecosystem Restoration encourages ecosystem conservation and restoration to support sustainable livelihoods, address climate change, and protect biodiversity from 2021-2030.[48]

NbS are central to multiple Sustainable Development Goals, and are also recognized in the Sendei Framework on Disaster Risk Reduction.

The recognition of the role that biodiversity loss plays in the spread of zoonotic disease has provided additional momentum behind NbS, highlighting the significant public health and economic importance of conservation. There are strong calls for a "green recovery" that prioritizes NbS and use of Covid

---

42. IUCN. 2019. *Nature-based Solutions in Nationally Determined Contributions: Synthesis and Recommendations for Enhancing Climate Ambition and Action by 2020*. https://portals.iucn.org/library/sites/library/files/documents/2019-030-En.pdf

43. UNFCCC. 2015. Paris Agreement. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

44. Seddon, N., Daniels, E., Davis, R., Chausson, A., Harris, R., Hou-Jones, X. et al. 2020. Global recognition of the importance of nature-based solutions to the impacts of climate change. Global Sustainability 3, e15. https://doi.org/10.1017/sus.2020.8.

45 United Nations Environment Programme.2021. Adaptation Gap Report 2020. Nairobi.

46. Dasgupta. 2021. *The Economics of Biodiversity: The Dasgupta Review.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/957629/Dasgupta_Review_-_Headline_Messages.pdf

48. IUCN. 2020. Promoting Nature-based Solutions in the Post-2020 Global Biodiversity Framework. https://www.iucn.org/sites/dev/files/promoting_nbs_in_the_post-2020_global_biodiversity_framework.pdf

48. UNEP. 2021. About the UN-Decade. https://www.decadeonrestoration.org/about-un-decade

stimulus spending to support NbS as a cost-effective way to advance these multiple connected policy objectives.[49] A recent report from UNEP calls for a tripling of investments in NbS by 2030 and a four-fold increase by 2050 to meet climate, biodiversity and land degradation targets.[50]

Nature-based Solutions can Help Achieve National Policy Goals in LAC

UNDP has produced a series of policy briefs identifying the role and opportunities for NbS in NDCs for LAC countries including Bolivia, Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Peru, and St. Vincent and Grenadines.[51] Across LAC, studies have shown potential climate mitigation, adaptation, and disaster risk reduction benefits related to forest, wetland, coastal, and grassland restoration and improved management. These benefits can directly impact individuals, for example by increasing farm profitability through improved soil nutrient management, or communities, such as through improved protection against storm surges.

These policy briefs show that all of the LAC countries identified above have committed to NbS in their NDCs and national development plans and strategies with the explicit goals of supporting both mitigation and adaptation. Specified NbS commitments include sustainable forest management, agroforestry, and agriculture, as well as watershed and coastal management and protection, silviculture, and wetland restoration. For example, Colombia's NDC includes commitments for mitigation, adaptation, and conservation through protecting, managing, and restoring forest ecosystems, as well as adaptation commitments through wetland management and sustainable management of agricultural lands.[52]

Countries articulate multiple reasons for investing in NbS. Because many NbS provide production- or health-related ecosystem services, NbS can support mitigation goals by reducing greenhouse gas emissions, and sequestering carbon, while improving air, water, or nutrient quality, reducing disaster risk, and enabling sustainable livelihoods to increase resilience to future climate change. For example, the NbS benefits to Bolivia's NDC include a mitigation potential of over 160 Mt CO^2e/year, and co-benefits beyond mitigation include sustainable forest management to enable food production, reduce climate vulnerability, and empower women; forest restoration to provide greener public spaces, agroforestry opportunities, and flood damage protection; and forest protection to reduce heat stress, improve water security and air quality, and eliminate illegal deforestation activity, empowering Peasant and Indigenous Nations and Peoples and creating livelihood opportunities based on sustainable biodiversity use. Bolivian wetland protection and restoration are cited as pathways to increase and improve water for human consumption, create opportunities for a new tourism industry, and reduce air, water, and soil pollution that also supports biodiversity. Finally, grassland agricultural

49. Pörtner, H.O., Scholes, R.J., Agard, J., et al.. 2021. IPBES-IPCC co-sponsored workshop report on biodiversity and climate change; IPBES and IPCC. DOI:10.5281/zenodo.4782538

50. United Nations Environment Programme. 2021. State of Finance for Nature 2021. Nairobi. https://www.unep.org/resources/state-finance-nature

51. UNDP. 2021. Nature-for-Climate Briefing Series.

52. UNDP. 2021. Nature-for-Climate Briefing: Strengthening Nature-based Solutions to Enhance Implementation of Colombia's Nationally Determined Contribution

land protection, management, and restoration are prioritized for their ability to enable more, more inclusive, and more resilient livelihood opportunities, increase food and water security and food system climate resilience, and reduce land degradation for higher quality and productivity.[53]

Beyond directly contributing to mitigation targets and increasing adaptive capacity to meet countries' international commitments, NbS can play a role in meeting national development goals. The policy briefs identify a broad range of national plans to which NbS contribute: national economic development plans, national adaptation plans, national biodiversity strategies, agricultural strategies, climate change strategies, nutrition and food security plans, forest and soil plans, water strategies, and sustainable energy policies. For example, El Salvador explicitly includes NbS in four of its current development policies: the 2017 National Disaster Risk Management Plan, the National Integrated Water Resource Management Plan, the 2018-2028 National Food and Nutrition Security Policy, and the 2015-2030 National Fisheries and Aquaculture Sustainable Development Plan; and five current environmental policies: the National Biodiversity Strategy and Action Plan, the Bonn Challenge Pledge, the National Climate Change Plan, the 2011-2030 National Forest Policy, and the 2018-2022 Restoration Action Plan. These plans and policies include objectives for protecting, managing, and restoring forest and coastal ecosystems, wetlands, and agricultural lands for the co-benefits discussed above.[54]

53. UNDP. 2021. Nature-for-Climate Briefing: Strengthening Nature-based Solutions within Bolivia's Nationally Determined Contribution

54. UNDP. 2021. Informe de la Naturaleza para el Clima: Fortalecimiento de las Soluciones Basadas en la Naturaleza dentro de la Contribución Determinada a Nivel Nacional del Salvador

Comparative Analysis of Existing Toolkits

Introduction

A clear understanding of the economic value of NbS and how it changes in the context of climate change is essential for the identification of sustainable and nature-friendly land-use policies, infrastructure investments, job creation, and livelihood opportunities. Frameworks guiding the process of analysis of the benefits and costs of NbS are therefore powerful tools that can influence program continuation, expansion, termination, and the flow of resources for NbS.

Many resources have been developed by donors, technical agencies, NGOs and academics to support the design and implementation of NbS and the related concept of ecosystem-based adaptation. These documents provide a wide range of guidance for designing, implementing and evaluation of NbS. For this analysis, we considered only those resources that specifically provided guidance on cost-benefit analysis of NbS in the context of climate adaptation. We reviewed toolkits that were explicitly about NbS, but also ecosystem-based adaptation, ecosystem services, green growth, green infrastructure and natural capital. Broad toolkits, as well as those intended for use in specific ecosystems such as forestry and marine and coastal ecosystems were included. We considered a resource to be a toolkit if it contained guidance on specific steps, tools or a process for either selecting NbS or assessing them. We distinguished "toolkits" from a stand-alone tool, in that toolkits also provided context and guidance to support the assessment process.

The websites of the following organizations and communities of practice were reviewed to identify toolkits: UNDP, UNEP, CBD, FAO, FEF, CGIAR, OECD, World Bank, WRI, IUCN, IIED, IISD, GIZ, GCA, WWF, GGGI, TNC, Climate-eval, CI, USAID, SwissRe, McKinsey and Co, UK DEFRA, Care International, Natural Capital Coalition, and adaptationcommunity.net. In addition to searching these websites, we also consulted with experts to identify additional toolkits, and reviewed identified sources for references to other resources.

A total of 137 resources were screened for inclusion, and a final sample of 45 toolkits were reviewed and included in this analysis. Toolkits were excluded for being published before 2010, not being freely available online, providing tools but not guidance on how to use those tools, not being specific to climate adaptation interventions, and supporting project design rather than cost-benefit analysis.

Each toolkit was reviewed to identify its approach to cost-benefit analysis of NbS. Drawing on the literature on the benefits and costs of NbS, we identified categories of benefits and costs and assessed each source for its guidance on incorporating these benefits and costs into analysis of NbS (Table 1). We also assessed other aspects of guidance including the intended users, geographic focus, calculation method recommended for analysis, and any other relevant information. We did not conduct our analysis with a preconceived notion of what an "ideal toolkit" would include; rather we assessed the structure and information of each to identify its strengths and weaknesses, assembling seven case studies on toolkits that provided outstanding or highly relevant guidance and

noting the components that a new toolkit would most benefit from including (see case studies in the appendix). Given the objectives of the scoping exercise that this report is part of, we were particularly interested in toolkits that provided guidance on incorporating job and livelihood benefits and climate considerations.

Toolkit focus

Across the sample, we found that: a) there is a wide variety in the types of environmental and socio-economic benefits included in guidance, b) costs were not universally accounted for in the toolkits, and c) the balance of conceptual theory and practical guidance for identifying benefits and costs varied but most resources tended to emphasize theory. Concrete guidance for on-the-ground implementation was less common. Some information was commonly not included, including analysis

Table 1. Benefits and Costs Analyzed

Category	Benefit/Cost	Definition
Socio-economic Benefits	Jobs, Livelihoods, and New Income	New or expanded jobs or livelihood opportunties, or new or increased income opportunities that result from project implementation.
	Health	Improvements in health (including nutrition and food security), such as improved nutrition or disease reduction from higher air or water quality, due to the project.
	Culture and Community	Improvements in community well-being and cultural goods or activities, such as governance, knowledge, local natural beauty, and recreational opportunities due to the project.
	Peace	Improvements in rates of conflict and violence due to the project, including through governmental environmental diplomacy for environmental peacebuilding.
Ecological Services Benefits	Disaster Risk Reduction	Improvements in disaster risk reduction or management due to the project, including the development of early warning systems, flood mitigation, or soil erosion management.
	Water Quality and Infrastructure	Improvements to water resources such as improved water quality, filtration, or irrigation efficiency.
	Soil/ Pollination/ Habitat/ Biodiversity	Improvements in biodiveristy-relevant benefits including soil quality, pollination, and biodversity through project activities such as promotion of sustainable agricultural practices, conservation of pollination corridors and promotion of beekeeping, habitat conservation and restoration, and other activities leading to conserved, restored, or increased biodiversity.
	Micro-climate Regulation	Improvements in shade, local temperature, or local fire management through project activities.
	Energy/ Commodities/ Materials/ Medicine	Increased production of energy resources, commodities for sale, production input materials, and medicine through the project.
	Carbon Sequestration	Carbon sequestration through project activities, such as through planting trees or restoring forests.
Costs	Financial Costs	Direct costs of the project, as presented in the project budget.
	Opportunity Costs/ Trade-offs	The cost of not implementing alternative approaches, due to competing potential use of the same funds or other resources.
	Environmental Costs	Any negative environmental impacts or environmental degradation resulting from project implementation, such as pest control impacts, greenhouse gas emissions from construction materials, or ecosystem effects of the production of a new agricultural good.
	Other Costs	Any other costs of the project. These may include negative social costs, such as failure to incorporate indigenous stakeholders or needs, or potential negative impacts on regional politics.

of the benefits of vulnerability reduction, guidance on incorporating stakeholder feedback in data collection, and equity considerations in analysis.

Some toolkits narrowly focused on cost-benefit analysis of NbS, while others were designed to provide guidance for the entire project from ideation to replication and cost-benefit analysis was only a small component. The *Guidebook for Monitoring and Evaluating Ecosystem-based Adaptation Interventions* (GIZ, 2020) is one example that supports practitioners in integrating evaluation into delivery, which helps to inform NbS design as well as ensuring a high-quality dataset for the evaluation phase. Some resources like *Targeted Scenario Analysis: A New Approach to Capturing and Representing Ecosystem Service Values for Decision-making* (UNDP, 2013) focused on the economic value of NbS in general, but didn't emphasize the information needed for a cost-benefit analysis.

The majority of toolkits were globally applicable, although several pertained to one or more ecosystems or regions, or both. Some provided guidance specific to forests, coasts, agricultural land, grasslands, wetlands, marine areas, or coral reefs. For example, *Environmental Economics for Marine Ecosystem Management Toolkit* (GEF, 2018) was strong in its focus on marine ecosystems. Others used case studies primarily from one area, but the guidance itself was more broadly applicable and not specific to one geographic region. Whenever possible, our analysis includes resources specific to LAC and priority ecosystems in the region. The 2017 GIZ toolkit, *Valuing the Benefits, Costs and Impacts of Ecosystem-based Adaptation Measures*, for example, provides case studies that either are drawn from or relate closely to NbS in LAC communities and ecosystems.

While not necessarily geographically-specific, the majority, but not all, toolkits focused on developing country contexts. Notable exceptions were *Ecosystem Service Assessment for Decision-Making* (BioDiv Canada, 2017) and UK DEFRA's *Enabling a Natural Capital Approach: Guidance* (2020), which focused on Canada and the UK, respectively. These toolkits, which provided valuable guidance, were more detailed in their description of ecosystems than most resources, but some of the guidance was less relevant to LAC. In addition to different ecosystems, a significant difference in toolkits focusing on NbS in developed versus developing country contexts was the way they incorporated benefits associated with jobs and livelihoods. Toolkits focusing on developing regions typically emphasized livelihood benefits, whereas those focused on developed regions more frequently discussed benefits to jobs and employment. Across all geographic areas, however, benefits for individuals and smallholder enterprises were more likely to be discussed than benefits for larger businesses.

A few toolkits also connected NbS to the broader international environmental policy context through references to Sustainable Development Goals, Nationally Determined Contributions, or Green Growth. These were typically organized in relation to the larger policy goals, rather than the impacts of an NbS project. An example is the *Environmental Economics for Marine Ecosystem Management Toolkit* (GEF, 2018), which provides substantial background on the political and legal foundations for marine

ecosystem management, as well as guidance on developing sustainable financing. Because of this resource's specialization in international marine ecosystems, it provides a detailed base of policy information on which users without legal backgrounds can draw as they navigate a complex legal landscape.

NbS valuation is occasionally cited as a means of legitimizing NbS projects as climate-related interventions or unlocking access to climate finance, such as in V*aluing the Benefits, Costs and Impacts of Ecosystem-based Adaptation Measures* (GIZ, 2017). Other toolkits are very tailored to the specific policy context of REDD+ and provide detailed guidance on assessing benefits and costs for REDD+ implementation.

Most toolkits provided conceptual guidance on cost-benefit analysis rather than detailed information on particular NbS benefits and costs, their indicators, and potential data sources. A notable exception was *Ecosystem Service Assessment for Decision-Making* (BioDiv Canada, 2017). Instead of specifying particular costs and benefits to include in the analysis, most resources provided more general information about the importance of conducting a cost-benefit analysis and then detailed guidance on how the user can choose which costs and benefits to include and/or how to think about quantifying these. The *Guidebook for Monitoring and Evaluating Ecosystem-based Adaptation Interventions* (GIZ, 2020) is an example – it provides a framework on which users can build their own cost-benefit analyses tailored to their project alongside up-to-date resources to provide technical assistance for modeling or advanced calculations related to the analysis.

Some toolkits provided lists of resources to support cost-benefit analysis including models and information on methodologies for quantification or monetization. *Monitoring & Evaluation of Adaptation to Climate Change*, (GIZ, 2016) serves as a directory of relevant GIZ cost-benefit analysis resources organized by scale, featuring information on the target audience, type of guidance, and available languages of each resource. Although they provided useful guidance on program design or direction for where to find more specialized resources, toolkits that did not delineate the types of costs and benefits to include in a cost-benefit analysis may be less useful to practitioners new to the process of conducting cost-benefit analyses or incorporating NbS into projects.

Cost-Benefit Analysis and Alternative Approaches

Many of the toolkits provide guidance on the process of valuation to monetize NbS individual benefits and costs for an aggregate cost-benefit analysis. Value is often assigned based on the market prices of goods and services. Because NbS provide traded goods and services, it is possible to monetize the benefits of NbS based on market prices, but this will underestimate the full value of NbS because not all benefits have market prices, or the market price may not represent the full value. Willingness to pay is a common technique to elicit values for nature that goes beyond the market prices, and can

include willingness to pay for the benefits of NbS or willingness to pay for the avoided losses that NbS prevent.

Some of the toolkits introduce alternative approaches to cost-benefit analysis such as a Natural Capital Accounting, which seeks to integrate natural capital into economic assessments, including national accounts, as an alternative to traditional metrics of economic value, such as GDP. At its simplest, natural capital accounting seeks to think of nature as a set of assets. This approach is discussed in detail in *Enabling a Natural Capital Approach: Guidance* (UK DEFRA, 2020). Natural Capital Accounting is not an appropriate methodology for making individual investment decisions for NbS, as it is intended to provide a comprehensive analysis of the natural assets available, often over time. It seeks to incorporate the full value of nature, while cost-benefit analysis is focused on the marginal costs and benefits of implementing an intervention.

Other toolkits introduced a related approach known as ecosystem service assessment. This approach is distinct from a cost-benefit analysis because it does not emphasize monetization; rather it provides a framework for holistic assessment of multiple types of data, from qualitative stakeholder feedback or household survey data to quantitative or monetized information from environmental and economic models, with an emphasis on identifying, collecting, and assessing the full range of ecosystem services associated with a particular intervention. The *Ecosystem Service Assessment for Decision-Making (BioDiv Canada, 2017)* is a good example that introduces this approach. Unlike cost-benefit analysis, while this approach can show the economic value of NbS, it cannot be used to make the business case for NbS because it does not directly assess costs.

Managing Coasts with Natural Solutions: Guidelines for Measuring and Valuing the Coastal Protection Services of Mangroves and Coral Reefs (World Bank, 2016) provides a few examples of how advanced approaches for evaluating the impact of NbS have been applied to decision-making. One of these is scenario analysis, which involves estimating or modelling future scenarios with and without the NbS. Targeted Scenario Analysis is a more specific type of scenario analysis, which applies scenario analysis in a particular sector or to a particular stakeholder and is explained in UNDP's *Targeted Scenario Analysis* (2017).

Data Collection Guidance

The output of a cost-benefit analysis is dependent on its inputs; two cost-benefit analysis frameworks may present divergent analyses of the same NbS merely by focusing on different sets of costs and benefits or collecting different types of data. Cost-benefit analyses necessarily cannot incorporate perfect measurements of all possible benefits and costs due to constraints on resources including time and funding, and value decisions about what to include and how to collect that information.

There was a wide variety of approaches to data collection included in the toolkits. Collecting

stakeholder feedback, information on environmental impacts, and economic data were often highlighted. Data collection methods varied from the use of technical, highly quantitative tools such as ecosystem and economic models that allow for specific monetary values to be assigned to the benefits and costs of NbS to more qualitative, potentially stakeholder-informed tools, such as participant or household surveys and literature reviews that may capture more non-economic benefits and costs. The *Ecosystem Service Assessment for Decision-Making* (BioDiv Canada, 2017) identifies several case studies in which local NbS planning and design processes included the development of locally-specific biophysical models for vegetation and hydrological systems and social models such as for food systems, housing, and policy. The toolkit also identifies publicly available models such as SWAT for soil erosion and lists tools including ARIES, ENVISION, and InVEST that model a range of ecosystem services. The toolkit notes that it is important to understand what is and is not included in these models and how that information related to the NbS in question before using these models. The WRI, CEH, and ESPA *Guide to Selecting Ecosystem Service Models for Decision-Making* (2018) provides substantial guidance on selecting and applying ecosystem service models, with an in-depth analysis of four major tools for modeling carbon and water impacts.

While most guidance focuses on directly assessing the benefits and costs in the specific context, this is not the only option. Literature-based valuation, in which evaluators adjust values developed by prior studies to estimate the NbS impact, and Inferred Value Analysis, in which NbS impact is estimated based on previous experience and other similar projects are alternatives to directly collecting intervention-specific data.

Toolkits assembled by development agencies were most likely to prioritize stakeholder feedback, whereas consulting firms, academic institutions, and global organizations emphasized more technical data analysis. This correlation is loose and may not reflect a broader trend in organizational approaches.

Guidance on Benefits and Costs

Many toolkits did not provide detailed guidance on analyzing benefits and costs of NbS. Even where specific costs and benefits were highlighted as relevant, costs and benefits were typically organized into larger categories – or appeared only in terms of broader categories – such as "economic benefits" or "ecosystem benefits." These resources did, however, reflect and incorporate social benefits beyond ecosystem and economic benefits, such as social resilience, culture, and education, as seen in the prevalence of toolkits (27/45) including health and social benefits in Table 2.

Based on our assessment of the 45 toolkits reviewed, the most common benefits included were: a) Jobs, Livelihoods, and Income, b) Health and Social Benefits, c) Soil, Pollination, Habitat, and Biodiversity, and d) Water Quality and Infrastructure. Toolkits typically did not include precise information on how to calculate each impact, as different NbS contexts may lend themselves to

Table 2. Benefits and Costs included in Toolkits

	Benefits: Socio-economic		Benefits: Ecological Services						Costs	
Toolkit Title	Jobs, Livelihoods, and Income	Health and Social	Disaster Risk Reduction	Water Quality and Infrastructure	Soil, Pollination, Habitat, and Biodiversity	Micro climate regulation	Energy, Materials, and Medicine	Carbon Sequestration	Financial	Other
Environmental Economics for Marine Ecosystem Management Toolkit	X	X	X		X		X	X	X	X
Guidance Documents to Economic Valuation of Ecosystem Services in International Waters Projects	X	X	X	X	X	X	X	X	X	
Nature-based Solutions for Adapting to Water-related Climate Risks	X	X	X	X	X		X	X	X	X
The Value of Reefs for Protecting the Most Vulnerable Populations in the Dominican Republic, Jamaica, and Grenada	X	X	X		X		X			
Managing Coasts with Natural Solutions: Guidelines for Measuring and Valuing the Coastal Protection Services of Mangroves and Coral Reefs	X	X	X	X	X	X	X	X	X	X
Coastal Capital: Ecosystem Valuation for Decision Making in the Caribbean		X	X	X	X	X	X		X	
Tools for Measuring, Modelling, and Valuing Ecosystem Services: Guidance for Key Biodiversity Areas, Natural World Heritage Sites, and Protected Areas	X	X	X	X	X		X	X		X
Enabling a Natural Capital Approach (ENCA): Guidance		X		X	X		X		X	X
Ecosystem-based Adaptation: Question-based Guidance for Assessing Effectiveness	X	X							X	X

	Benefits: Socio-economic		Benefits: Ecological Services						Costs	
Toolkit Title	Jobs, Livelihoods, and Income	Health and Social	Disaster Risk Reduction	Water Quality and Infrastructure	Soil, Pollination, Habitat, and Biodiversity	Micro climate regulation	Energy, Materials, and Medicine	Carbon Sequestration	Financial	Other
Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST)		X		X	X		X	X		
Social Values for Ecosystem Services (SolVES)	X	X			X					
Toolkit for Ecosystem Service Site-based Assessment (TESSA)		X	X	X			X	X		X
Targeted Scenario Analysis: A New Approach to Capturing and Representing Ecosystem Service Values for Decision-making										
Adaptation Solutions Taxonomy	X	X	X	X	X	X	X			
Co$ting Nature		X	X		X			X	X	X
EU Guidance on Integrating Ecosystems and their Services into Decision-making			X	X	X					
Valuing the Benefits, Costs and Impacts of Ecosystem-based Adaptation Measures	X	X	X	X	X	X			X	X
Guidebook for Monitoring and Evaluating Ecosystem-based Adaptation Interventions	X	X	X	X	X	X				
Guidelines for Ecosystem-based Approaches to Climate Change Adaptation and Disaster Risk Reduction	X	X	X		X	X		X		
ALivE Tool	X				X					
Guidance Manual on Valuation and Accounting of Ecosystem Services for SIDS	X	X	X	X	X	X	X			X
Guidance for Valuing Nature in Nationally Determined Contributions	X	X	X	X	X			X		

	Benefits: Socio-economic		Benefits: Ecological Services						Costs	
Toolkit Title	Jobs, Livelihoods, and Income	Health and Social	Disaster Risk Reduction	Water Quality and Infrastructure	Soil, Pollination, Habitat, and Biodiversity	Micro climate regulation	Energy, Materials, and Medicine	Carbon Sequestration	Financial	Other
Learning tool on Nationally Appropriate Mitigation Actions (NAMAs) in the agriculture, forestry and other land use (AFOLU) sector	X	X	X	X	X	X		X	X	X
Guidance Manual on Value Transfer Methods for Ecosystem Services										
Ecosystem Service Assessment for Decision-Making	X	X	X	X	X	X	X	X		X
Integrating Ecosystem Values into CBA		X	X	X	X	X	X	X		
Monitoring & Evaluation of Adaptation to Climate Change										
Valuing Nature Conservation		X	X	X	X	X	X	X	X	X
Forests and Water: Valuation and Payments for Forest Ecosystem Services	X	X	X	X	X				X	X
Increasing the Policy Impact of Ecosystem Service Assessments and Valuations										
Cost-benefit Analysis for Climate Change Adaptation Policies and Investments in the Agriculture Sectors									X	X
Green Growth Assessment & Extended Cost Benefit Analysis		X	X	X	X		X	X	X	X
An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects	X	X	X	X	X	X	X	X	X	X
A Guide for Incorporating Ecosystem Service Valuation into Coastal Restoration Projects		X	X	X	X				X	X

	Benefits: Socio-economic		Benefits: Ecological Services						Costs	
Toolkit Title	Jobs, Livelihoods, and Income	Health and Social	Disaster Risk Reduction	Water Quality and Infrastructure	Soil, Pollination, Habitat, and Biodiversity	Micro climate regulation	Energy, Materials, and Medicine	Carbon Sequestration	Financial	Other
Workshop Guide: Using Facilitation Techniques to Integrate Ecosystem Services into Coastal Management Decisions		X		X	X					
Valuing Forest Ecosystem Services		X	X	X	X	X	X			
PRISM – Toolkit for Evaluating the Outcomes and Impacts of Small/medium-sized Conservation Projects										
Adaptation Made to Measure										
AdaptME Toolkit										
Participatory Monitoring, Evaluation, Reflection and Learning for Community-based Adaptation (PMERL)										
Good Practice Study on Principles for Indicator Development, Selection, and Use in Climate Change Adaptation Monitoring and Evaluation										
Impact Evaluation Guidebook for Climate Change Adaptation Projects										
Simplified Guidelines for Social Cost-Benefit Analysis of Climate Change Adaptation Projects on a Local Scale	X	X			X					
Incentives for Ecosystem Services										
Sustainable Asset Valuation Tool: Natural Infrastructure	X	X	X	X	X	X	X	X	X	X

different calculation approaches. For example, a NbS that consists of payment for ecosystem services would collect data on change in income using different methods than one that supports market access for farmers. Several toolkits describe a range of data collection approaches that may be relevant to their audience, from issuing household surveys to using remote sensing to modeling with social, economic, environmental, and climate data.

Many toolkits focused on the benefits of NbS with little discussion of the costs. Only 21/45 toolkits included some mention of direct financial costs, and just 19/45 toolkits addressed any other type of cost, such as opportunity costs or environmental degradation. For financial costs, this may be due to the relative ease of accessing project costs, or the prevalence of existing tools and guidance for estimating project costs and developing a project budget. Many benefits of NbS are more difficult to estimate, and more likely to be excluded from a basic cost-benefit analysis, justifying their emphasis in guidance documents. Still, resources like *Valuing the Benefits, Costs and Impacts of Ecosystem-based Adaptation Measures* (GIZ, 2017) stand out for substantive discussion of incorporation of both costs and benefits, including emphasis on the analysis's application as a tool for decision-making.

While most toolkits included some of the benefits and costs analyzed, as can be seen in Table 2, 9 toolkits did not discuss any specific benefits or costs.These toolkits did not provide detailed guidance on which types of benefits and costs to include, acknowledging that each project will have unique impact areas and therefore distinct sets of benefits and costs that a guidance toolkit may not be able to prescribe.

Incorporation of Climate Change

Impacts related to climate change were included in many of the toolkits, even though there were few focused on adaptation in particular. Adaptation was often implicitly addressed through inclusion of the benefits of more resilient social and physical infrastructure. For example, in *Valuing the Benefits, Costs and Impacts of Ecosystem-based Adaptation Measures* (GIZ, 2017), resilience is included as a goal for both human and natural systems, such as farmers' capacity to cope with effects of drought, building and empowering community knowledge to develop resilience strategies. In one of the case studies, community resilience was measured by a self-reported survey and biophysical resilience was assessed using a vulnerability index that incorporated both the probability and magnitude of expected sensitivity to climate change. Several of the ecological services benefits that were assessed relate to reducing damage from the impacts of climate change, including disaster risk reduction, biodiversity conservation, and energy benefits. Still, many ecosystem services were framed in terms of the more localized environmental conservation and restoration benefits of NbS without explicit acknowledgement or merely passing reference to climate adaptation benefits. In total 28/45 of the toolkits explicitly refer to adaptation benefits and 26 refer to climate resilience benefits.

Much less common was any discussion of how climate change may influence the benefits (or the

costs) of NbS. One of the few toolkits to include guidance on incorporating climate change was UNDP's *Targeted Scenario Analysis: A New Approach to Capturing and Representing Ecosystem Service Values for Decision-making* (UNDP, 2013). Targeted scenario analysis is one way to incorporate future climate change into NbS assessment, and can help improve understanding of the potential effects of climate change on NbS delivery. Climate uncertainty is accounted for in targeted scenario modeling by developing a comparison between a model of a scenario where the NbS is implemented and one where it is not. This modeling exercise then needs to be combined with more traditional cost-benefit analyses to arrive at a calculation of the benefits and costs of NbS under climate change. As with other toolkits, the *Targeted Scenario Analysis* resource reiterates that the appropriate inputs to, duration, and applications of climate models depends on the NbS in question, its expected impacts, and its "given planning horizon."

While UNDP's *Targeted Scenario Analysis* offered some guidance, no toolkit provided sufficient guidance on how to incorporate future changes in climate into the analysis of the benefits or costs of NbS. This is an area with significant scope for further development.

Where Is the Gap?

Although there are clearly many resources available to guide NbS practitioners, this review did not find a cohesive, "one stop shop", especially not one that is specifically regionally oriented to projects in the Caribbean and Latin America. An excellent toolkit would include:

- Theoretical grounding connecting climate, NbS, and the role of cost-benefit analysis
- Specific, although not prescriptive, guidance on benefits and costs and how to determine which benefits and cost to include in a cost-benefit analysis
- A resource guide to support valuation and modeling/calculations
- The resource should be tailored to the geographic area and ecosystems of relevance, including case studies and step-by-step examples using proposed or implemented NbS projects in the area.
- Discussion of calculation of benefits and costs over time to facilitate long-term planning
- Incorporation of climate projections and climate modeling

UNDP-supported portfolio, funded by the GEF, AF, and GCF

Overview

We examined 15 projects in UNDP's adaptation and biodiversity and ecosystems portfolios in the LAC region implemented since 2010 to identify the evidence of the benefits and costs of NbS within the UNDP portfolio (See appendix for a full list of projects). The goal of this analysis was not to comprehensively assess the evidence emerging from projects in UNDP's portfolio, but rather to survey the type of data that projects have collected and reflect on trends across the portfolio in order to better inform recommendations for further work in this area. It is important to note that this analysis did not identify whether a project had benefits, it identified whether the project documents explicitly provide data on the listed benefits and costs. Based on analysis of the project designs, it is clear that many projects likely deliver more benefits than are captured in the project data. This gap suggests that there are opportunities for more rigorous and comprehensive data collection and reporting to demonstrate additional value from NbS.

We assessed the data from NbS projects based on the benefit and cost categories identified in our review of the literature and survey of existing toolkits (Table 1). This allowed for a comparison of the current practices for reporting benefits and costs in UNDP-supported projects and the best practices synthesized from the literature and existing toolkits. The aim of this analysis was three-fold: a) to identify which benefits and costs were most commonly identified in project data, b) to identify

Ecuador: Capturing the Socio-economic and Ecological Benefits of Sustainable Certification

The *Sustainable Development of the Ecuadorian Amazon: Integrated Management of Multiple Use Landscapes and High Value Conservation Forests project* (2017- 2023), funded by the Global Environment Facility, enables access to credit and markets for participants to encourage sustainable production in high conservation value landscapes, among other elements. This project will ultimately feature an initiative to help Amazonian producers enter and increase sales in the European cocoa market by defining and tracing sustainable and deforestation-free cocoa production, with similar initiatives for livestock and coffee. Sustainable certification for cocoa has been found by evaluators to increase the volume of products sold on foreign markets three-fold, with simultaneous ecosystem service benefits including supporting biodiversity and carbon sequestration.

Evaluation of the Ecuador project has therefore included a combination of socioeconomic and ecological benefits, such as market and credit access for farmers, sustainable land use management, and forest conservation. These connections have been especially important during the Covid-19 crisis, as staff worked to develop strategic alliances with private companies to set fair prices for products that would help producers continue to earn their livelihoods. The project is further working to build a more resilient supply chain by developing an online marketplace to connect local producers directly with buyers and sellers, to maintain commercial relationships for participants.

consistent gaps and areas for improvement, and c) to identify projects that could serve as models for incorporating analysis of the benefits and costs of NbS. As highlighted in UNEP's Adaptation Gap Report, there is a significant gap in evidence on the effectiveness and cost-effectiveness of NbS, and the projects supported by UNDP have significant potential to contribute to filling that gap.

As discussed previously, cost-benefit analysis can play a role in all stages of policy and project development. While projects may have incorporated cost-benefit analysis into the design phase, this analysis focuses only on the data collected by projects on the benefits and costs of NbS during implementation. Therefore, this analysis represents only a partial picture of the ways that cost-benefit analysis currently are incorporated into projects. While an analysis of the role of cost-benefit analysis in project design would also be of interest in a complete exploration of the role of cost-benefit analysis for NbS projects, it was beyond the scope of this report.

UNDP-Supported Project Data

The portfolio of projects supported by UNDP and financed by the GEF, AF and GCF includes a wide range of diverse NbS across the region. Data collected from these projects plays a critical role in demonstrating the benefits of NbS and contributes to the evidence base for the economic case for NbS. Overall, these projects included some data on the various benefits and costs assessed. However, there were gaps both in data collected and the quality of the data that make comprehensive cost-benefit analysis difficult. Unless this information is captured, it is difficult to fully assess the evidence emerging from these projects.

Table 3 shows the data on benefits and costs shared from each project supported by UNDP in the LAC region. While there appears to be quite extensive coverage of benefits and costs based on Table 3, this scoping exercise captured the range of benefits and costs without addressing the quality of data. For this reason, a project document that briefly mentions that NbS 'created local jobs' is recorded as including data on jobs, livelihoods, and income in Table 3, as is a project that specifies the number of jobs created, whether they are temporary or long-term, and the annual salary. To further explore the quality of data included in project documents, additional research is necessary.

The extent and type of data collected across projects ranged greatly. Even those projects that provided exemplary models of data collection still had limitations. A project in Cuba performed a cost benefit analysis focused on protective services provided by mangroves with substantial, quantified data on mangrove ecological services but little information on social or economic benefits, although the project was known to have them. A project in Guatemala collected rich qualitative data on socioeconomic benefits of NbS in a series of stakeholder interviews as well as some data on ecological services, but this information was not quantified. In this project, while there was evidence of ways that NbS increased access to new livelihoods, this was not quantified in terms of the

Table 3. Overview of Data Included in Project Documents

	Benefits: Socio-economic		Benefits: Ecological Services						Costs	
Project (Country and PIMS number)	Jobs, Livelihoods, and Income	Health and Social	Disaster Risk Reduction	Water Quality and Infrastructure	Soil, Pollination, Habitat, and Biodiversity	Micro climate regulation	Energy, Materials, and Medicine	Carbon Sequestration	Financial	Other
Argentina 4841	X	X		X	X				X	
Brazil 4659	X	X			X	X			X	
Brazil 5896	X	X			X				X	
Colombia 3882	X	X	X	X	X		X	X		
Colombia 4720	X	X		X	X	X	X	X		
Colombia 4805	X	X	X	X	X				X	
Colombia 5715	X	X			X				X	
Colombia 5757	X	X	X	X	X				X	
Costa Rica 5140	X	X	X	X	X				X	
Cuba 5090	X	X	X	X	X	X	X	X	X	X
Ecuador 5606	X	X			X		X	X	X	
Guatemala 4386	X	X	X	X	X		X		X	X
Guatemala 5581	X	X		X	X		X	X	X	
Honduras 5704	X	X	X		X	X	X	X	X	
Honduras 5839	X	X		X	X		X		X	X

Note: This analysis only includes data from project implementation. More information may have been collected on benefits and costs as part of the project design phase but was not considered here.

number of people participating in each type of livelihood activity, making it difficult to translate into transferable evidence of effectiveness.

Both sets of socio-economic benefits: jobs, livelihoods, and income and health and social benefits are mentioned in all the project evaluations. Every project identified benefits to jobs, livelihoods, and income such as access to markets and credit or increased income from payments for ecosystem services, with a wide range of specificity in primarily qualitative terms, but with very limited quantitative data. Similarly, the data on other socio-economic benefits are typically briefly described in qualitative terms such as increased food security, knowledge of climate change for community planning, and environmental governance for peace.

Projects also included data on ecosystem services benefits from NbS. Unlike the socio-economic benefits that were universally addressed, while some ecosystem service benefits were widely included in analysis, there was greater variation in which ecological services were included. This may be because NbS are often designed with specific ecosystem services in mind and therefore projects are collecting data on these ecosystem services in particular. Benefits to soil, pollination, habitat, and biodiversity were included in every project. Water quality and infrastructure were the second most common ecosystem benefits addressed, featuring in 10/15 evaluations, and energy, materials, and medicine benefits were the third most discussed, in 8/15 evaluations. While there was more variation in whether certain ecosystem service benefits were included in project data, this data was much more likely to be quantified, and in some cases even monetized.

Finally, the extent to which project costs are included varied across project documents. Most documents included the financial costs, such as the project budget, but only Guatemala 4386, Cuba 5090, and Honduras 5839 addressed the possibility of other costs of the project, including the potential for adverse environmental effects or climate impacts and opportunity costs for other

Cuba: Comprehensive Analysis of the Benefits and Costs of Mangrove Ecosystem Services

The *Reduction of Vulnerability to Coastal Flooding through Ecosystem-based Adaptation in the South of Artemisa and Mayabeque Provinces in Cuba* project (2014-2020), funded by the Adaptation Fund, consisted of ecosystem-based adaptation efforts to restore mangrove forests that generated forestry jobs and related livelihood and income opportunities. The project partnered with National Forestry Enterprises to generate new forestry jobs and raise incomes, more than doubling the number of employees in one of two agroforestry companies involved from 20 to 55 and quadrupling their pay. In addition to forestry jobs, the Cuba project created livelihood opportunities for vulnerable populations: the development of a coastal trail expanded beekeeping and ecotourism opportunities that particularly benefitted women. Invasive species eradicated during the project implementation were used to produce charcoal, pallets to support export sales, and beehive boxes. Increased fishery productivity, observed through increased volume and diversity of marine fauna, due to improved water quality and vegetation cover, directly increased participant income as well.

Clearly, the project's jobs, livelihoods, and income benefits were directly connected to ecological services - Cuba was the only project with evaluation data on all types of ecological services identified in Table 1, from disaster risk reduction due to the flood protection effects of mangrove and coastal restoration to the carbon sequestration benefits of increased mangrove forest coverage. The project evaluation additionally addressed a wide range of potential project costs - financial, opportunity, and environmental.

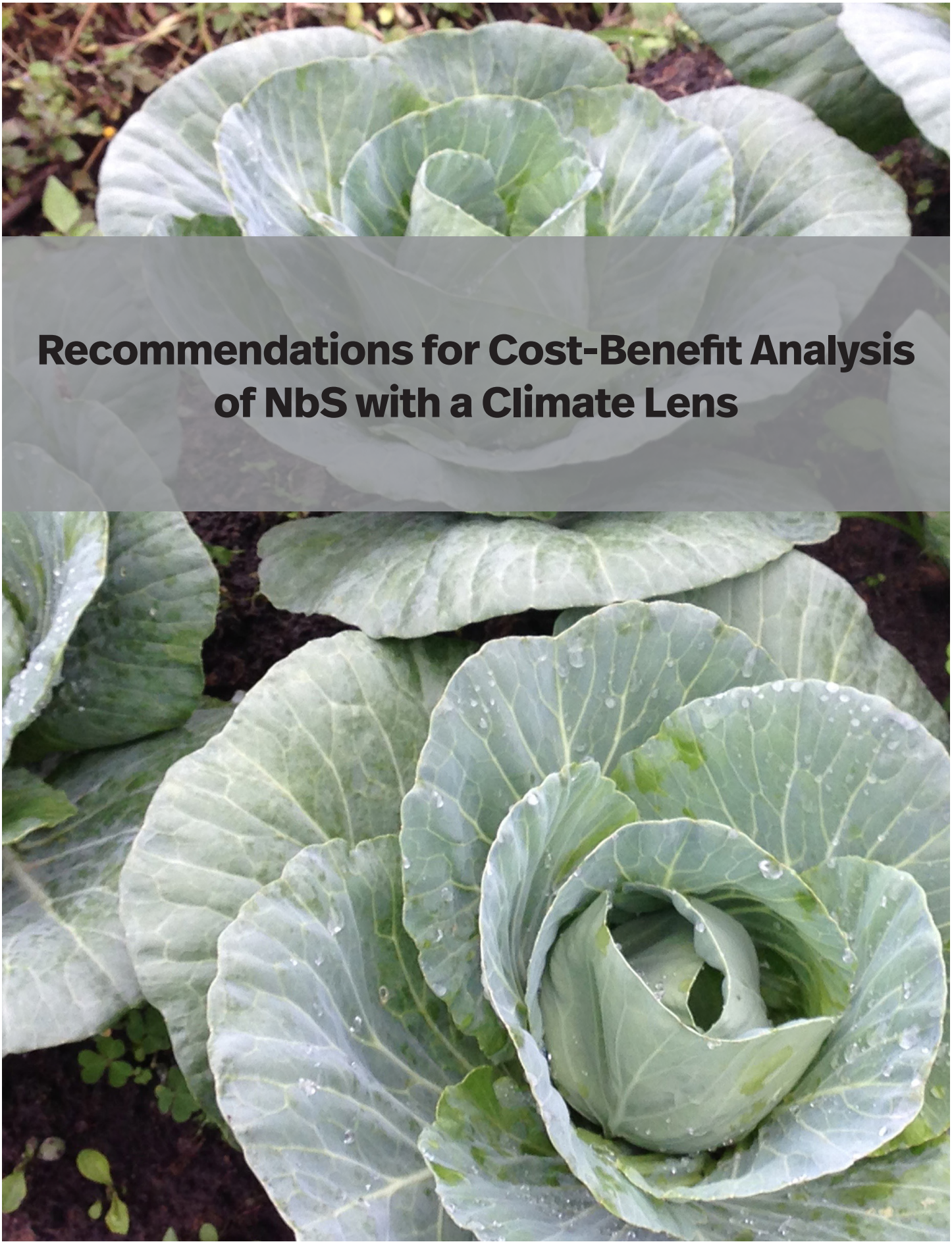
potential projects. A more complete review of the costs of a project would provide a solid foundation for accurate cost-benefit analysis.

One challenge was that similar data was not collected across different types of benefits. Project data typically featured quantified or even monetized data on ecological service data but limited quantification of social and economic data. This made it difficult to directly and rigorously compare these different types of benefits in a cost-benefit evaluation. Another challenge was that cost data was primarily limited to the implementation costs of the project, and apart from a few exceptions, projects did not include information about other potential costs, such as environmental costs or costs due to uncertainty.

Types of Indicator Data to Collect

While the appropriate data to assess project costs and benefits are somewhat dependent on the nature of the project being implemented, data on social and economic in addition to ecological services benefits and the number of participants or people affected is essential to include to show the full extent of the project's effect. NbS directly impact jobs, livelihoods, and incomes,[57] and this data both helps to identify the full impact of the project and can make a compelling economic case for decision-makers to continue to fund projects. Other social impacts that projects frequently have are on participant or community health, food and nutrition, recreation and tourism, in addition to other community impacts, and collecting more rigorous data on these benefits would add weight to the argument for continued and future investment in NbS.

57.Boyle and Kuhl. 2021. Nature-based Solutions are Job and Livelihood Solutions. Policy Brief. School of Public Policy and Urban Affairs, Northeastern University and United Nations Development Programme. https://www.adaptation-undp.org/node/6650



Recommendations for Cost-Benefit Analysis of NbS with a Climate Lens

Gaps in Existing Toolkits

Across the toolkits, there are clear gaps in guidance that would directly support cost-benefit analysis of the UNDP LAC portfolio. There is no cost-benefit analysis toolkit that contextualizes guidance to the LAC region, which would allow the toolkit to directly address the relevant ecosystems, economies, and policies in the region. This may involve addressing the effect of local climate commitments or sustainable development goals on NbS or vice versa. Situating the role of NbS in climate mitigation, adaptation, and resilience priorities that are specified in broader climate policy can help identify and support compelling arguments for governmental or organizational investment in NbS.

Additionally, there is limited guidance for assessing NbS with multi-scalar effects. For example, a project may include activities that improve local water quality and have upstream benefits to the broader watershed or the water quality in nearby urban centers. Without guidance for identifying and incorporating these broader impacts in the cost-benefit analysis, the evaluation may simply include improved local water quality and underestimate the project benefits relative to its costs.

A NbS toolkit should help practitioners incorporate cost-benefit guidance into the full project cycle, starting with project design. Evidence of benefits and costs is more easily collected during project implementation; therefore, guidance on cost-benefit analysis will have greater benefit to practitioners if it supports the design of a data collection approach alongside the rest of the project. For example, if a project includes payment for ecosystem services for carbon sequestration, practitioners should include the number and quantity of payments to participants for future evaluation of the income-enhancing benefits for project participants.

Notably, the application of climate scenario modeling to NbS cost-benefit analysis was not thoroughly addressed in most of the toolkits. Climate scenario models can support NbS project design, identifying expected changes in local climate that may affect project implementation and impact, as well as evaluation, serving as a baseline scenario against which the effects of the intervention can be compared. In a cost-benefit analysis, this tool can help identify the "business-as-usual" outcome, such as an expected amount of flood damage, and therefore the savings that the project has created, for example through improved water management that prevents flooding and therefore the cost of flood damage. Climate scenario models can also support project design by enabling designers to take into account climate projections and "climate-proof" interventions, for example, by selecting crops that are likely to be adapted to current and future climate scenarios.

Because the climate is rapidly changing, typical climatic conditions at the beginning of a project design may not serve as a realistic baseline by the end of the project, and climate scenario models help to bridge this gap. Such modeling may identify additional benefits of investments in NbS under future conditions, enhancing the argument for NbS investments. It may also identify limits of NbS under future conditions, allowing for realistic expectations of the benefits and costs of NbS.

Recommendations

Despite the limits of existing guidance on building the evidence of the costs and benefits of NbS, our analysis and in particular, the case studies of promising toolkits, highlight best practices identified through the review of 45 toolkits. Based on these findings, we recommend that a NbS cost-benefit analysis toolkit begins with an introduction that includes key terms and concepts, a theoretical foundation, and relevant norms and values. This introduction should use accessible language and include a section for communicating with stakeholders, specifically identifying information that is relevant and convincing to policymakers for investment decisions.

While there is widespread agreement that NbS are beneficial, the challenge is to make an economic case for investments in NbS as an alternative to traditional infrastructural investments. With this in mind, the toolkit should make the case for why collecting data on the benefits and costs of NbS is necessary and will support advocacy and decision-making.

The toolkit should feature a section that describes the theoretical foundation of cost-benefit analysis and contextualizes it, simplifying relevant policy frameworks and their effect on the analysis of the benefits and costs of NbS as well as connecting NbS interventions to broader climate and development goals and policies.

The toolkit should clarify the different stages during which cost-benefit analysis can be incorporated. It should discuss how cost-benefit analysis can inform investment decisions and selection of strategies, including comparing across alternatives and accounting for projected climate scenarios. It should also cover how cost-benefit analysis can support adaptive management during policy and project implementation, and how evaluations can use cost-benefit analysis to strengthen the evidence base for NbS.

The toolkit needs to incorporate information, tools, and guidance for cost-benefit analysis specific to NbS with a data collection framework that can be implemented alongside NbS interventions. It is important that a data collection and methods section highlight the importance of stakeholder participation throughout the evaluation process, including expert consultation. This should include a distinct stepwise evaluation process for benefits and costs with support from and references to other tools, organized by broad categories with information on how to apply the process. Very concrete guidance on what kind of data needs to be collected for different potential benefits and costs should be included, and comparisons of different methodologies for collecting this data in data-scarce contexts, including strengths and limitations, is needed. The guidance should recognize the significant challenges of data collection (logistical, capacity-wise, and financial) and help practitioners make informed decisions that are realistic for the development contexts in which projects are being implemented. Users would benefit from localized case studies throughout the toolkit with

suggestions for lessons learned and difficult subjects, including logical questions and innovative solutions.

A key feature of NbS that should be taken into consideration is the long-term nature of these investments, and the fact that benefits may take time to be fully realized. The toolkit should discuss the importance of calculating benefits and costs over time, and incorporate recommendations for addressing future projections of benefits and costs into the analysis.

To support the collection of evidence on the benefits and costs of NbS, the toolkit should incorporate a discussion on how to manage uncertainty (driven by climate but also socioeconomic conditions) and causality in impact evaluation. Formal impact evaluations can help establish that the observed benefits were caused by the intervention, and would not have occurred in the absence of the intervention. However, these require rigorous data collection, before and after project implementation, and appropriate comparison (control) groups, which may or may not feasible or desirable. Despite its limitations, guidance on the monetization of benefits and costs, including socio-economic benefits and costs should be included in the toolkit, as this can help communicate the economic case for NbS to decisionmakers for whom economic language may be particularly persuasive.

Finally, the implications of climate change, including the use of business as usual or baseline projections should feature prominently in the toolkit. Discussion of climate modeling should be incorporated, including recommendations for potential models, data requirements, and strengths and limitations of different modeling approaches should be considered. The toolkit should provide guidance both on how to identify the needs for NbS under a changing climate, as well as assess the capacity of the NbS to deliver the anticipated benefits under climate change.

Conclusions

This report examined current and recommended cost-benefit analysis for NbS projects in LAC, comparing existing guidance with current practices in UNDP-supported projects. The benefits of NbS are numerous, including high potential for combined economic, social, and environmental benefits compared to investment in other (e.g., gray infrastructure) policies or projects.

Section II discussed the value and rationale for conducting cost-benefit analysis. Key benefits and costs of NbS were introduced, categorized broadly into socio-economic benefits and ecosystem services benefits. Both financial and non-financial costs were discussed. The challenges (but also the value) of monetizing benefits and costs was addressed. Additionally, the importance of incorporating projected climatic change in evaluation of future impacts grows as climate change more drastically affects local weather, disaster risk, and ecosystems and therefore affects the expected costs and benefits of NbS projects.

Section III discussed the growing relevance of NbS in the region. NbS feature in the mitigation, adaptation, and disaster risk reduction components of climate strategies, plans, and agreements as well as biodiversity and land degradation agreements at the national and international level. Because NbS can simultaneously achieve multiple policy objectives, they are well-suited to address complex policy problems, such as building equitable resilience to climate change or meeting the multiple social, economic, environmental, and health needs of COVID recovery planning.

As the overview of the process of cost-benefit analysis discussed, the benefits and costs of NbS may be broad and qualitative and therefore can be difficult to rigorously measure and compare, so many frameworks, toolkits, and guidance documents have been produced to support practitioners and evaluators as they prepare for and undertake cost-benefit analysis before, during, or after project design and implementation. Section IV surveys 45 existing toolkits that provide guidance on assessing NbS. Many toolkits provide information and recommendations that are relevant and should be incorporated into guidance for assessment. However, there is not yet a toolkit that fully meets the needs of UNDP-supported biodiversity and climate adaptation projects in LAC.

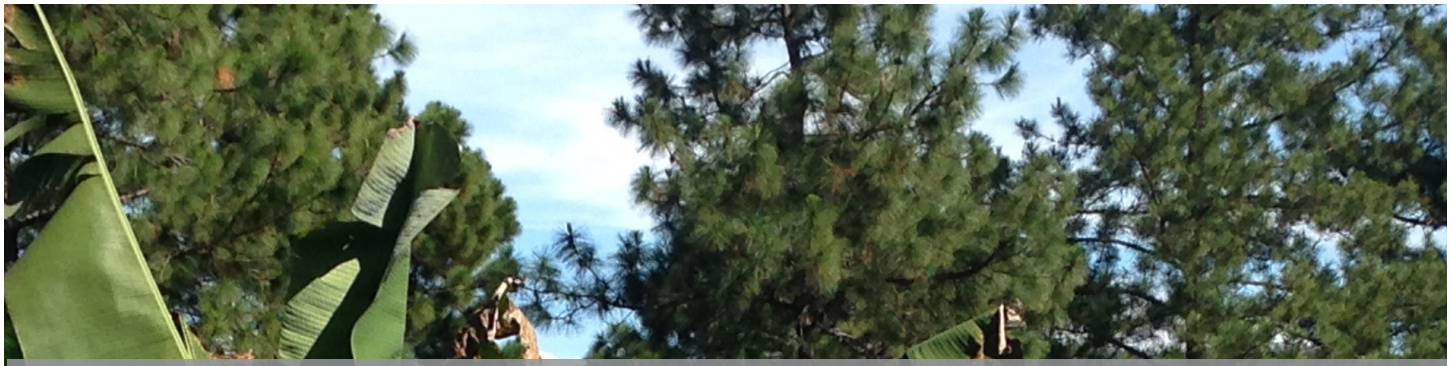
Section V analyzed case studies from UNDP's portfolio to assess current data collection on benefits and costs of NbS and the evidence base in the portfolio. The assessment found evidence of a wide range of benefits and costs, and significant variation in data collection, which highlights the importance of flexibility in terms of benefits and costs included in any cost-benefit analysis guidance document. This survey identified areas for improvement in the current use of cost-benefit analysis across the portfolio which would allow the portfolio to generate a stronger evidence-base on the value of NbS.

The report concludes with recommendations for the development of a toolkit to fill the identified gaps in existing toolkits. In particular, there are limited resources to address the systemic drivers

and effects of climate change. Rigorous and theoretically-sound cost-benefit analysis is a central component of evidence-based decision making to invest in the most effective projects, therefore it is essential to have a strong NbS evaluation framework.

Several existing toolkits that may be particularly relevant for UNDP are included in the appendix. Many of these involve the development of a clear theory- and value-based cost-benefit assessment framework that is appropriate to the geographic and policy context and stakeholder needs, as well as its consistent implementation alongside the NbS project.

This report summarizes a preliminary scoping exercise for evaluating NbS in LAC, with recommendations for major considerations in and practical elements of a climate-informed NbS cost-benefit analysis toolkit. With the support of this toolkit, practitioners and evaluators will be able to identify the complete social, economic, and environmental impacts of investment in NbS, as well as areas for continued cost reduction and benefit gain.



Appendices

Appendix A: Toolkits Reviewed

1. Anglia Ruskin University, Birdlife International, University of Cambridge, RSPB, Tropical Biology Association, UN Environment, University of Southampton. 2017. ***Toolkit for Ecosystem Service Site-based Assessment (TESSA).*** http://tessa.tools/download

2. ASAP. 2020. ***Adaptation Solutions Taxonomy.*** https://publications.iadb.org/en/adaptation-solutions-taxonomy#:~:text=The%20ASAP%20Adaptation%20Solutions%20Taxonomy,SMEs%20may%20require%20targeted%20support

3. BioDiv Canada. 2017. ***Ecosystem Service Assessment for Decision-Making.*** https://biodivcanada.chm-cbd.net/sites/biodivcanada/files/inline-files/2017_Ecosystem_Services_Toolkit.pdf

4. Care. 2014. ***Participatory Monitoring, Evaluation, Reflection and Learning for Community-based Adaptation (PMERL).*** https://insights.careinternational.org.uk/media/k2/attachments/CARE_PMERL_revised_manual.pdf

5. Climate – eval. 2015. ***Good Practice Study on Principles for Indicator Development, Selection, and Use in Climate Change Adaptation Monitoring and Evaluation***. https://www.eartheval.org/sites/ceval/files/studies/Good-Practice-Study.pdf

6. Conservation Evaluation. 2017. ***PRISM – Toolkit for Evaluating the Outcomes and Impacts of Small/Medium-sized Conservation Projects.*** https://conservationevaluation.org/PRISM-Evaluation-Toolkit-V1.pdf

7. Conservation International. 2019. ***Guidance for Valuing Nature in Nationally-Determined Contributions***. https://www.conservation.org/docs/default-source/publication-pdfs/guide-to-including-nature-in-ndcs.pdf?sfvrsn=99aecda2_2

8. UN Convention on Biological Diversity (UN CBD). 2018. ***Guidelines for Ecosystem-based Approaches to Climate Change Adaptation and Disaster Risk Reduction.*** https://www.cbd.int/sbstta/sbstta-22-sbi-2/EbA-Eco-DRR-Guidelines-en.pdf

9. Duke University Nicholas Institute. 2019. ***Workshop Guide: Using Facilitation Techniques to Integrate Ecosystem Services into Coastal Management Decisions.*** https://nicholasinstitute.duke.edu/sites/default/files/publications/Workshop-Guide-Facilitation-Techniques.pdf

10. EKLIPSE. 2017. ***An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects.*** http://www.eklipse-mechanism.eu/apps/Eklipse_data/website/EKLIPSE_Report1-NBS_FINAL_Complete-08022017_LowRes_4Web.pdf

11. European Commission. 2019. ***EU Guidance on Integrating Ecosystems and Their Services into***

Decision-making. https://ec.europa.eu/environment/nature/ecosystems/pdf/SWD_2019_305_F1_STAFF_WORKING_PAPER_EN_V2_P1_1042629.PDF

12. FAO. 2015. ***Learning Tool on Nationally Appropriate Mitigation Actions (NAMAs) in the Agriculture, Forestry and Other Land Use (AFOLU) Sector.*** http://www.fao.org/3/a-i4642e.pdf

13. FAO and ECE. 2018. ***Forests and Water: Valuation and payments for forest ecosystem services.*** https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/UNECE_Forest_Valuation_0.pdf

14. FAO. 2018. ***Cost-benefit Analysis for Climate Change Adaptation Policies and Investments in the Agriculture Sector.*** https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/Cost-benefit_Analysis_for_Climate_Change_Adaptation_Policies_and_Investments_in_Agriculture.pdf

15. FAO. 2019. ***Valuing Forest Ecosystem Services.*** http://www.fao.org/3/ca2886en/CA2886EN.pdf

16. FAO. 2020. ***Incentives for Ecosystem Services.*** http://www.fao.org/in-action/incentives-for-ecosystem-services/toolkit/en/

17. GEF. 2018. ***Environmental Economics for Marine Ecosystem Management Toolkit.*** https://iwlearn.net/manuals/governance-toolkit

18. GEF. 2019. ***Guidance Documents to Economic Valuation of Ecosystem Services in International Waters Projects.*** https://iwlearn.net/resolveuid/0ffc8834-af39-488a-852a-4348fee97b85

19. Global Green Growth Institute. 2018. ***Green Growth Assessment & Extended Cost Benefit Analysis.*** https://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/Green_Growth_Assessment_and_Extended_Cost_Benefit_Analysis.pdf

20. GIZ. 2013. ***Adaptation Made to Measure.*** https://www.adaptationcommunity.net/?wpfb_dl=52

21. GIZ. 2015. ***Impact Evaluation Guidebook for Climate Change Adaptation Projects.*** https://www.adaptationcommunity.net/?wpfb_dl=260

22. GIZ. 2016. ***Increasing the Policy Impact of Ecosystem Service Assessments and Valuations.*** https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/Increasing_Policy_Impact.pdf

23. GIZ. 2016. ***Monitoring & Evaluation of Adaptation to Climate Change.*** https://ndcpartnership.org/toolbox/giz-adaptation-monitoring-and-evaluation-toolbox

24. GIZ. 2017. ***Valuing the Benefits, Costs and Impacts of Ecosystem-based Adaptation Measures.***

https://www.weadapt.org/knowledge-base/ecosystem-based-adaptation/valuing-the-benefits-costs-and-impacts-of-eba-measures

25. GIZ. 2020. ***Guidebook for Monitoring and Evaluating Ecosystem-based Adaptation Interventions.*** https://www.adaptationcommunity.net/download/ME-Guidebook_EbA.pdf

26. IIED, IUCN, and UNEP. 2017. ***Ecosystem-based Adaptation: Question-based Quidance for Assessing Effectiveness.*** https://pubs.iied.org/pdfs/17606IIED.pdf

27. IISD. 2016. ***ALivE Tool.*** https://www.iisd.org/projects/alive-adaptation-livelihoods-and-ecosystems-planning-tool

28. IISD. 2019. ***Sustainable Asset Valuation Tool: Natural Infrastructure.*** https://www.iisd.org/publications/sustainable-asset-valuation-tool-natural-infrastructure

29. Insu-Resilience Global Partnership. 2019. ***The Value of Reefs for Protecting the Most Vulnerable Populations in the Dominican Republic, Jamaica, and Grenada.*** https://www.insuresilience.org/wp-content/uploads/2020/05/The-Value-of-Reefs_TNC_UCSC_InsuResilience-Integrated-Approaches-WG_20052020.pdf

30. IUCN. 2018. ***Tools for Measuring, Modelling, and Valuing Ecosystem Services: Guidance for Key Biodiversity Areas, Natural World Heritage Sites, and Protected Areas.*** https://portals.iucn.org/library/node/47778

31. KCL, AmbioTEK, UNEP, WCMC. 2020. ***Co$ting Nature.*** http://www.policysupport.org/costingnature

32. McKinsey & Co. 2020. ***Valuing Nature Conservation.*** https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/Valuing%20nature%20conservation/Valuing-nature-conservation.pdf

33. NEF Consulting. 2014. ***Simplified Guidelines for Social Cost-Benefit Analysis of Climate Change Adaptation Projects on a Local Scale.*** https://careclimatechange.org/wp-content/uploads/2014/08/CostBenefit.pdf

34. OECD. 2020. ***Nature-based Solutions for Adapting to Water-related Climate Risks.*** https://www.oecd.org/environment/nature-based-solutions-for-adapting-to-water-related-climate-risks-2257873d-en.htm#:~:text=Nature%2Dbased%20solutions%20for%20adapting%20to%20water%2Drelated%20climate%20risks,-Healthy%20ecosystems%2C%20and&text=Nature%2Dbased%20solutions%20(NbS),while%20also%20offering%20economic%20benefits

35. Stanford. 2020. ***Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST).*** https://naturalcapitalproject.stanford.edu/software/invest

36. TNC. 2015. ***A Guide for Incorporating Ecosystem Service Valuation into Coastal Restoration Projects.*** https://www.nature.org/media/oceansandcoasts/ecosystem-service-valuation-coastal-restoration.pdf

37. UK Department for Environment Food & Rural Affairs. 2020. ***Enabling a Natural Capital Approach (ENCA): Guidance.*** https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/869801/natural-capital-enca-guidance_2_March.pdf

38. UKCIP. 2011. ***AdaptME Toolkit.*** https://www.ukcip.org.uk/wp-content/PDFs/UKCIP-AdaptME.pdf

39. UNDP. 2013. ***Targeted Scenario Analysis: A New Approach to Capturing and Representing Ecosystem Service Values for Decision-making***. https://www.undp.org/content/undp/en/home/librarypage/environment-energy/ecosystems_and_biodiversity/Targeted-Scenario-Approach-2013.html

40. UNEP. 2013. ***Guidance Manual on Value Transfer Methods for Ecosystem Services.*** https://iwlearn.net/resolveuid/bbbdf2cd-b343-4c0a-99d6-e69bb8575953

41. UNEP. 2014. ***Guidance Manual on Valuation and Accounting of Ecosystem Services for SIDS.*** https://www.iwlearn.net/resolveuid/4430e5c6ed7743eaa5b0043355767e02

42. US Geological Survey. 2020. ***Social Values for Ecosystem Services (SolVES)***. https://www.usgs.gov/centers/gecsc/science/social-values-ecosystem-services-solves?qt-science_center_objects=0#qt-science_center_objects

43. USAID. 2018. ***Integrating Ecosystem Values into CBA.*** https://www.conservation-strategy.org/sites/default/files/field-file/Integrating_Ecosystem_Values_into_Cost-Benefit_Analysis-Recommendations_for_USAID_and_Practitioners.pdf

44. WAVES – World Bank. 2016. ***Managing Coasts with Natural Solutions: Guidelines for Measuring and Valuing the Coastal Protection Services of Mangroves and Coral Reefs.*** https://documents.worldbank.org/en/publication/documents-reports/documentdetail/995341467995379786/managing-coasts-with-natural-solutions-guidelines-for-measuring-and-valuing-the-coastal-protection-services-of-mangroves-and-coral-reefs

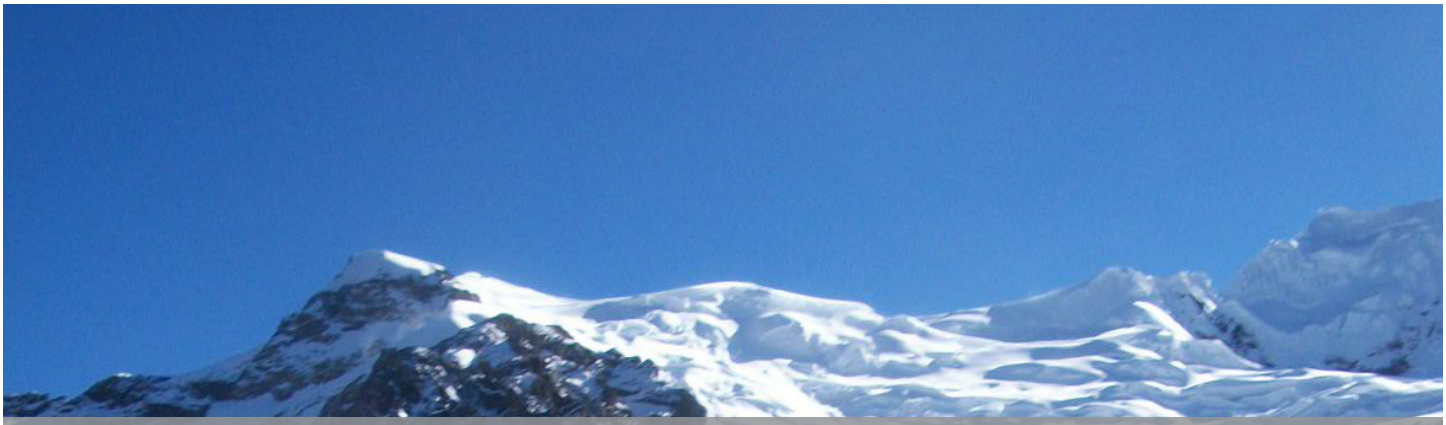
45. WRI. 2014. ***Coastal Capital: Ecosystem Valuation for Decision Making in the Caribbean.*** https://www.wri.org/publication/coastal-capital-ecosystem-valuation-decision-making-caribbean#:~:text=In%20the%20Caribbean%2C%20coastal%20ecosystem,of%20finance%20for%20coastal%20conservation

Appendix B: UNDP Projects Reviewed

Country	Project Number	Title	Portfolio (Climate Change Adaptation (CCA) or Ecosystems and Biodiversity (EBD))	Financing Organization	Expected Completion Date (in progress) or Implementation Dates (completed)
Argentina	4841	Sustainable Land Use Management in the Drylands of Northwest Argentina	EBD	GEF	2014-2021
Brazil	4659	Mainstreaming Biodiversity Conservation and Sustainable Use into NTFP and AFS production practices in Multiple-Use Forest Landscapes of High Conservation Value	EBD	GEF	2015-2021
Brazil	5896	Taking Deforestation out of the Soy Supply Chain	EBD	GEF	2017-2021
Colombia	3882	Payment for Ecosystem Services and Biodiveristy Conservation in the Coffee Sector	EBD	GEF	2010-2014
Colombia	4720	Forests 4 Peace	EBD	GEF	2014-2020
Colombia	4805	Reducing risk and vulnerability to climate change in the region of La Depresión Momposina in Colombia	CCA	AF	2012-2020
Colombia	5715	Connectivity and Biodiversity Conservation in the Colombian Amazon	EBD	GEF	2018-2024
Colombia	5757	Scaling up climate resilient water management practices for vulnerable communities in La Mojana	CCA	GCF	2018-2026
Costa Rica	5140	Strengthening Capacities of Rural Aqueduct Associations' (ASADAS) to ad-dress climate change risks in water stressed communities of Northern Costa Rica	CCA	GEF	2016-2021
Cuba	5090	Reduction of vulnerability to coastal flooding through ecosystem-based adaptation in the south of Artemisa and Mayabeque provinces	CCA	AF	2014-2020
Ecuador	5606	Sustainable Development of the Ecuadorian Amazon: integrated management of multiple use landscapes and high value conservation forests	EBD	GEF	2017-2023
Guatemala	4386	Climate change resilient productive landscapes and socio-economic networks advanced in Guatemala	CCA	AF	2015-2018

Country	Project Number	Title	Portfolio (Climate Change Adaptation (CCA) or Ecosystems and Biodiversity (EBD))	Financing Organization	Expected Completion Date (in progress) or Implementation Dates (completed)
Guatemala	5581	Promoting sustainable and resilient landscapes in the central volcanic chain of Guatemala	EBD	GEF	2018-2025
Honduras	5704	Agroforestry landscapes and sustainable forest management that generate environmental and economic benefits globally and locally	EBD	GEF	2018-2025
Honduras	5839	Adaptar C+	CCA	AF	2018-2023

Note: GEF: Global Environment Facility; AF: Adaptation Fund; GCF: Green Climate Fund



Appendix C: Toolkit Case Studies

This section provides several case studies of outstanding or highly relevant toolkits, including access and overview information, the strengths and weaknesses of each toolkit, and areas to incorporate or further develop in a UNDP NbS cost-benefit analysis toolkit. Each case study toolkit was selected because it shows a distinct approach to cost-benefit analysis guidance, with elements that illustrate components to incorporate into the creation of a new guidance document.

Valuing the Benefits, Costs and Impacts of Ecosystem-based Adaptation Measures

GIZ 2017

Available at: https://www.adaptationcommunity.net/wp-content/uploads/2017/12/EbA-Valuations-Sb_en_online.pdf

Overview

Available in English and Spanish, this resource is intended to guide the design, delivery, and use of Ecosystem-based Adaptation (EbA) valuation studies. As a closely-related concept, toolkits focused on EbA are highly relevant for analyzing NbS, especially in the context of climate change. The toolkit begins with overview information on the importance of EbA valuation to inform decision-making and a discussion of how to determine which impacts should be included in an EbA valuation exercise. Because this toolkit is intended to be broadly applicable globally, it does not focus on any particular adaptation strategies or specify all possible benefits, costs and impacts.

Strengths

This toolkit develops a rich theoretical foundation for the how and why of EbA valuation as well as case studies on how this process has occurred for projects around the world. GIZ's toolkit provides value for EbA practitioners through its digestible format. As readers follow the well-defined and discussed steps for EbA valuation, they are assisted by highlights and summary notes, brief international case studies, some resources, and clear graphics. The steps this toolkit identifies in the EbA valuation process are indicated in Figure 2.

Both costs and benefits are discussed in detail which is relatively unusual; fewer than half of the 45 toolkits reviewed included specific information on costs. This toolkit also offers guidance for application of EbA valuation

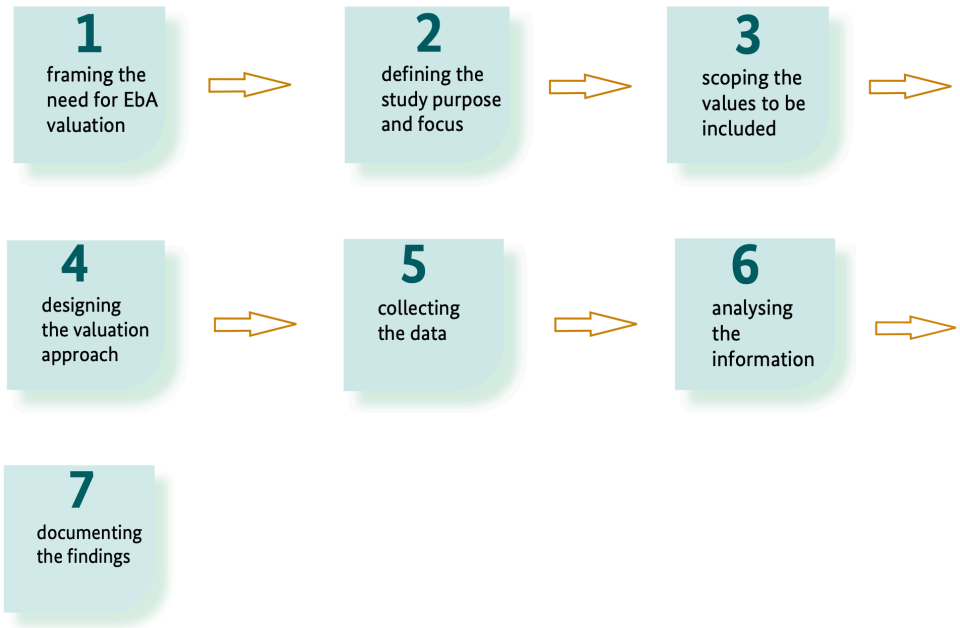


Figure 2. Steps in the Ecosystem-based Adaptation valuation process, from justification to documentation

output, as a decision-making tool and as leverage for continued or additional EbA program finance.

Weaknesses

Involving local stakeholders throughout the valuation process is one crucially missing component of this toolkit. The toolkit is also several years old and does not provide information on how EbA valuation relates to relevant climate policy. There is no discussion of mitigation activities or how they relate to adaptation and resilience, although the toolkit focuses on the latter.

Application to New Toolkit Development

A UNDP NbS cost-benefit toolkit would ideally build on the straightforward and theory-based guidance developed in this resource by:

- Providing localized, more relevant case studies that relate closely to practitioners and projects in Latin American communities and ecosystems.
- Including more information, relevant tools, and guidance for determining the inputs to an NbS valuation in practice, such as for how to identify impacts or additional (e.g., economic or qualitative) inputs to valuation, and providing example analyses.
- Refocusing the main audience to center NbS practitioners, evaluators, and stakeholders rather than decision-makers and how NbS valuation can help meet their goals, including applying NbS projects for pandemic recovery.
- Highlighting the importance of and ways to facilitate stakeholder participation throughout the process and the role of funding/organizational partnerships on project and valuation outcomes.
- Connecting NbS to broader climate policy goals and other climate actions such as mitigation efforts.

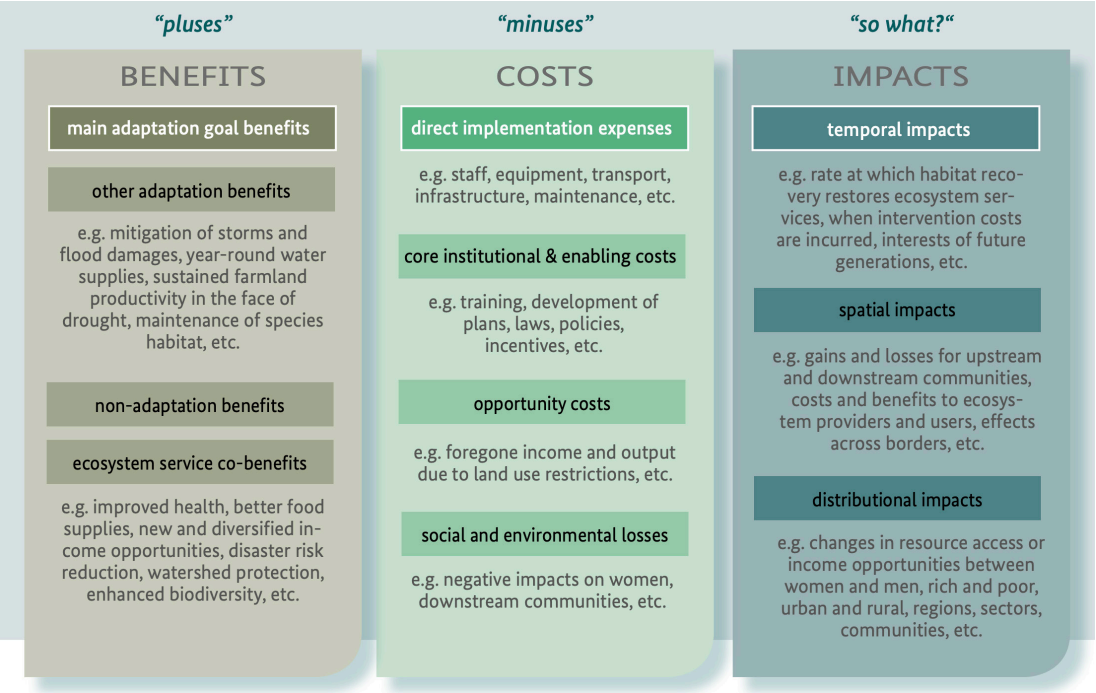


Figure 3. Benefits, costs, and impacts of Ecosystem-based Adaptation with subcategories and examples

Monitoring & Evaluation of Adaptation to Climate Change

GIZ 2016

Available at: https://ndcpartnership.org/toolbox/giz-adaptation-monitoring-and-evaluation-toolbox

Overview

Although this toolkit is a slidedeck rather than a document, it organizes a wide variety of monitoring and evaluation (M&E) resources simply and straightforwardly. Created to support adaptation M&E, resources in the toolkit are organized by scale: national, project, and multi-level guidance. The toolkit begins with a background section including the definition of adaptation M&E. Although particular impacts or methodologies are not highlighted, 11 tools that support adaptation M&E are briefly described and linked in the toolkit with information on the target audience, type of guidance included, and available languages for download. These tools help practitioners to keep track of adaptation plan implementation and evaluate outcomes.

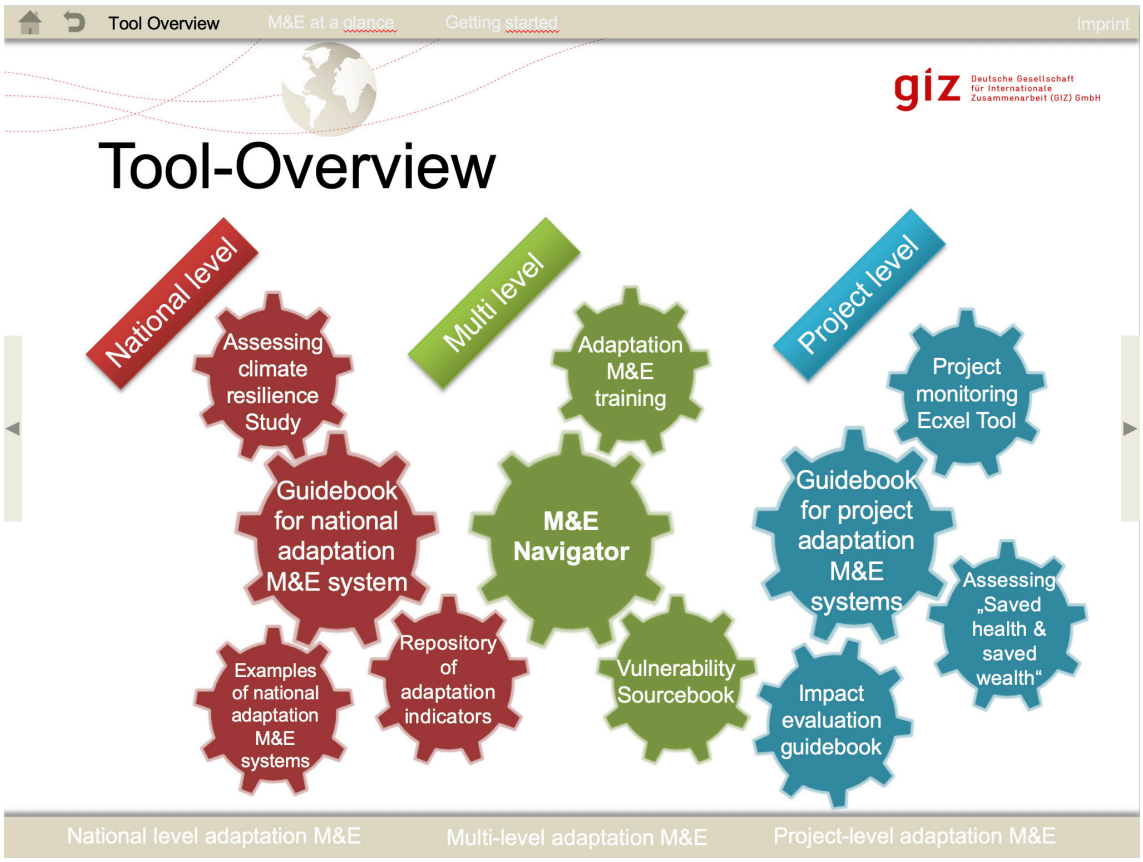


Figure 4. Overview of GIZ tools for monitoring and evaluating adaptation organized by scope

Strengths

GIZ's toolkit is most successful in providing a framework for practitioners seeking additional in-depth resources on adaptation M&E. By grouping these tools into three levels, users can immediately determine which set of tools will be relevant to the project they are monitoring and/or evaluating. The descriptive information further describes each tool in a paragraph including the depth of data in the tool, applicable audience, and approach to data presentation, e.g. case studies or indicator repository.

While the toolkit itself does not provide substantial guidance, the resources included provide case studies, example inputs, stepwise guidebooks, and training materials. The medium of presentation slides is somewhat unusual; however, the authors include a useful slide with notes on how to navigate the toolbox.

Weaknesses

This toolkit broadly addresses M&E for adaptation and therefore includes resources that projects focusing on NbS may not find relevant or specific enough to be useful. By organizing this toolkit by the tools' applicable levels, some desired guidance included in the toolbox may not fit the level of analysis – for example, work on evaluating vulnerability and resilience are specified in national and multi-level guidance but are not included in the project-level adaptation tools. Unfamiliar users may also find it difficult to identify where information overlaps between toolkits or in what order to review the tools as they develop and implement M&E. Finally, this toolkit is limited in that it is a review document specifically for GIZ-developed tools and lacks information on other relevant external resources.

Application to New Toolkit Development

Several of the features of this toolkit can inform practitioner-oriented guidance on NbS valuation, including:

- Organizing referenced materials by broad category with distinct sections for additional information on use and applicability of the tools in each category.
- Incorporating tools with considerations for assessing projects in particular ecosystems.
- Sharing links for each language in which the resource was published alongside overview information and target audience.
- Providing guidance information for the full cycle of M&E, from the development of the NbS to the evaluation of the project's outcomes.

Guidebook for Monitoring and Evaluating Ecosystem-based Adaptation Interventions

GIZ 2020

Available at: Available at: https://www.adaptationcommunity.net/download/ME-Guidebook_EbA.pdf

Overview

This Guidebook aims to help planners and practitioners who are interested in evaluating interventions in any ecosystem and national context. Through a theory based four-step process with substantial referencing, the Guidebook describes effective result communication and reporting to intervention beneficiaries, donors, and organizational leadership. The guidance presented is broadly applicable across all types of EbA interventions because it is intended for post-hoc analysis, based on the intervention's objectives and Theory of Change.

Rather than a comprehensive toolkit for evaluating EbA interventions, this is a newly-published basic framework for monitoring and evaluation approaches accompanied by information on where to find other tools that provide more guidance on specific questions or parts of the evaluation process. Because it is focused on monitoring and evaluation, this resource is best used in conjunction with other toolkits focusing on project development. One helpful feature is that it provides information on how to integrate evaluation into the project delivery.

The Guidebook provides some general information on types of indicators to use in evaluation and how to operationalize them, including ethical considerations, but by keeping these sections brief and referring users to external resources, may add confusion rather than clarity to this process.

Strengths

The thorough and stepwise nature of this Guidebook is an excellent resource for individuals analyzing NbS interventions using the most up-to-date guidance and tools. The Guidebook provides a strong theoretical foundation, although it does not provide very much support for users who may be new or have difficulty with modeling or calculation. An exemplary component of this Guidebook is the brief descriptions of sample evaluation processes for EbA intervention case studies with suggestions. Brief notes on case studies, a substantial additional resource section that is also heavily referenced throughout the Guidebook, and appendices for information on suggested equipment and data management add additional value to this toolkit.

Weaknesses

This is a fairly sophisticated toolkit and assumes a high level of knowledge of users. It would be useful to provide more resources in the text regarding industry best practices for the types of indicators to include, how to measure them, and how to overcome roadblocks in the evaluation process. More depth in the case studies could also support users looking for examples of what their process should include or exclude based on similar contexts or projects. Finally, highlighted information in this toolkit is called out either as complex tables or complex graphics. Breaking down information to more simplified visuals would make the key take-aways from this Guidebook more digestible to users.

Application to New Toolkit Development

This Guidebook presents an example of characteristics that would contribute to an excellent NbS valuation toolkit including:

- An introduction section that develops key terms, concepts, and theoretical foundation for analyzing NbS.
- Relatively brief, relevant case studies with suggestions for users looking to apply the lessons learned from the case study to their own project.

Figure 5. Ecosystem-based Adaptation implementation cycle including evaluation planning and delivery, with connections to corresponding Guidebook sections

Environmental Economics for Marine Ecosystem Management Toolkit

GEF 2018

Available at: https://iwlearn.net/manuals/governance-toolkit

Overview

The GEF's Environmental Economics for Marine Ecosystem Management Toolkit is a resource specific to evaluating projects in large marine ecosystems (LME). This resource delineates a framework for evaluation intended to raise awareness, improve sustainable finance and policy, and calculate and compare the distribution of ecosystem service benefits and costs. This toolkit is noteworthy for its focus on a specific ecosystem, its emphasis on economic valuation, and a concentration on values and ethics, particularly for good governance and stakeholder engagement and collaboration.

As an economics-based resource, the toolkit provides guidance on sustainable financing as well as the political and legal foundations for LME management. The GEF cites external resources for evaluation planning and other guidance, although it is a self-contained resource with background information on LME management economics and science and geographically-specific case studies. Although the toolkit does not identify specific benefits or costs to include in cost-benefit analyses of LME, it develops an approach to quantifying categories of benefits and costs.

Strengths

This toolkit successfully weaves together a wide literature on LME management, from foundational values and marine science to international maritime law and policy to provide an holistic resource for practitioners working in LMEs. The toolkit provides guidance to support the full process of program design and evaluation with recommended stepwise approaches from reviewing existing literature to inform design to communicating the evaluation results as a way to improve governance efficacy.

A unique but especially effective component of this toolkit results from its specialization in international LME. The toolkit draws on an ecosystem-specific ecological understanding of management projects as well as a substantial legal framework of maritime agreements which provides a contextual richness that is not found in more generic toolkits.

Weaknesses

The GEF's toolkit is not specific to NbS, even though it does focus on LMEs, and provides highly specialized background information such as on implementing more general ecosystem protection projects that are not necessarily relevant for NbS. Another weakness is that it does not address climate change and how to assess benefits or costs for mitigation or adaptation. Rather, it discusses benefits and costs of LME in general.

Application to New Toolkit Development

Although this toolkit is specific to one type of ecosystem, its features can inform NbS toolkit development:

- Beginning not only with a description of the task to be guided by the toolkit, but also a set of norms and values.
- Distributing topical case studies throughout the toolkit to address more difficult subjects, answer logical questions, or display innovative solutions.
- Identifying relevant legal and policy frameworks and their potential effect on the cost-benefit analysis.
- Supporting dissemination of findings with a section dedicated to communicating with stakeholders, policymakers, and other relevant actors.

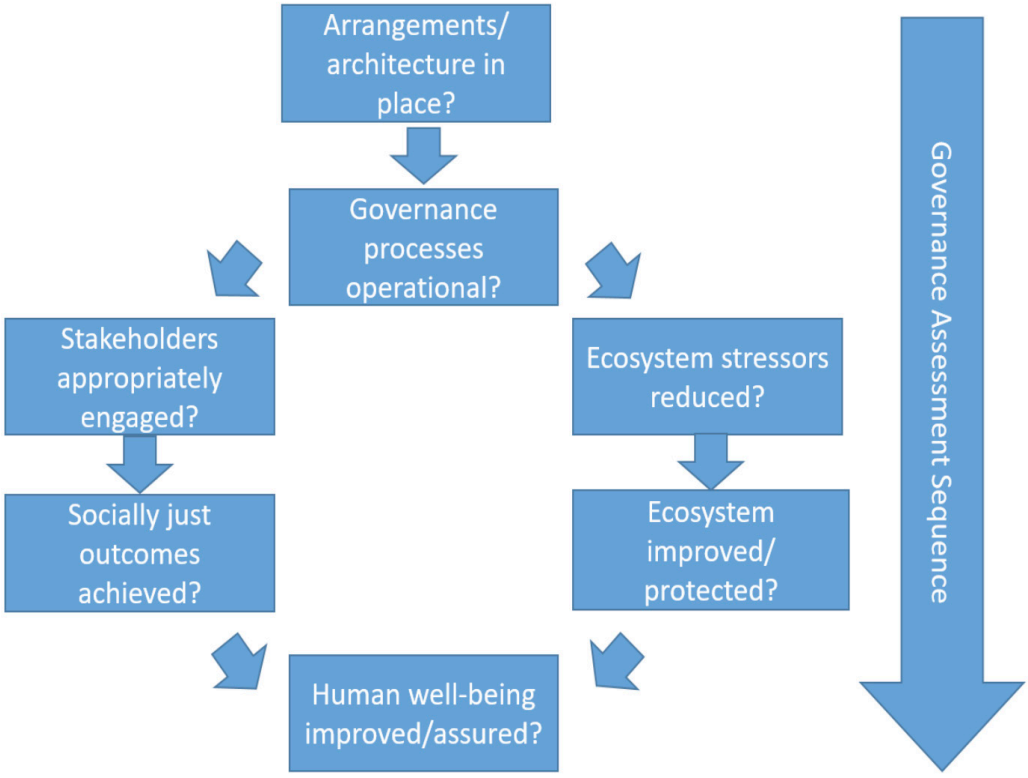


Figure 6. the GEF International Waters framework for identifying indicators relevant to a comprehensive assessment of governance design, processes, and outcomes

Enabling a Natural Capital Approach (ENCA): Guidance

DEFRA 2020

Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/869801/natural-capital-enca-guidance_2_March.pdf

Overview

Unlike other toolkits, DEFRA's toolkit is intended broadly to provide guidance for an audience "looking to learn more about natural capital and environmental valuation." As described in the toolkit, natural capital approaches take a systemic approach to understanding the interactions between ecosystems and human well-being , which is somewhat distinct from evaluating a NbS intervention by monetizing each of its benefits and costs. This toolkit is specific to the UK. However, it is unique in that it addresses costs as well as benefits in its guidance on economic valuation.

Strengths

ENCA: Guidance incorporates considerations across habitat types in the UK, including clear descriptions of the components of its natural capital framework and relationships between these components. Ecosystem services and their effects on human well-being are incorporated in the framework as distinctly categorized benefits and costs. This resource is intended for a general audience; although it discusses environmental economics, it uses simple language to explain complicated concepts. The Guidance also discusses limitations to the methodology, so that practitioners can avoid pitfalls and make a considered choice in approaches.

Table 4. Sample table section from ENCA: Guidance - Screening for natural capital impacts to help identify benefits and costs of Nature-based Solutions for evaluation

Screening question and guidance	Yes/Possibly/No
Is the proposal likely to have any effects on the use or management of land in the UK? Land is the basis for natural assets and the various "broad habitats " that occupy land: woodland, moorland, enclosed farmland, urban, semi-natural grassland, coastal margins. Any proposal that potentially affects management or use of the land, including through changing incentives, will be in scope.	
Is the proposal likely to affect the atmoshere in any way? This primarily relates to potential effects, positive or negative, on air quality or its composition- including GHG emissions. It also includes effects on levels of noise or tranquility.	

For practical application, this toolkit guides assessment with a thoughtful four-step process to inform monitoring and evaluation planning. Detailed guidance is followed by a general review of previous applications of natural capital approaches with lessons learned for practitioners.

Weaknesses

The toolkit's focus on the UK, including applying data from the National Ecosystem Assessment, means that the data it contains is not broadly applicable to other contexts. This is especially true for geographical regions that have very different ecosystems or economies, such as LAC. Further, this guidance document is not intended for evaluating adaptation projects in particular, and therefore lacks information that would aid practitioners in understanding how to assess those types of interventions.

Application to New Toolkit Development

ENCA: Guidance's unique approach to cost-benefit analysis shows approaches to include when developing future toolkits, such as:

- Considering alternative approaches to cost-benefit analysis of NbS, in this case a natural capital approach, and comparing their strengths and limitations.
- Ensuring accessibility to multiple stakeholders by using simple language and thorough descriptions of discipline-specific concepts.
- Include a stepwise process for evaluating both benefits and costs of NbS with support for determining which inputs to include.

Ecosystem Service Assessment for Decision-Making

BioDiv Canada 2017

Available at: https://biodivcanada.chm-cbd.net/sites/biodivcanada/files/inline-files/2017_Ecosystem_Services_Toolkit.pdf

Overview

The Ecosystem Services Toolkit provides a methodological framework and guidance for Canadian practitioners. The six-step framework encompasses the full range of assessment, from defining the issue and context to communicating findings. The toolkit contains detailed charts and diagrams, with examples from case study projects, highlighted tips, and linked worksheets that follow the steps of the framework. The toolkit's focus is on ecosystem services and it does not specifically address climate adaptation or the connections between the ecosystem and the local economy, although these topics are included briefly in relevant examples. This resource also has a substantial section dedicated to tools such as guidance for involving indigenous communities, lists and descriptions of indicators that can be used in a cost-benefit analysis, and considerations for valuing these indicators.

Strengths

This toolkit is notable for providing substantial guidance and resources for identifying indicators, data sources, and analytical tools for conducting cost-benefit analysis of ecosystem services. This concentration on methodology for data collection and assessment, including a set of impact descriptions, is unusual in toolkits that are typically more focused on theoretical foundations. This detail is possible because this toolkit is significantly longer than most. The toolkit explicitly aims to support evidence-based decision-making that improves human well-being and ensures environmental sustainability. The inclusion of social benefits of NbS is more comprehensive than in many toolkits.

Another strength of this toolkit is its broad applicability across scales: from the federal, provincial, territorial or regional scale to the watershed or municipal scale. This may be particularly useful for NbS that span geographical scales. Finally, the toolkit includes links to additional guidance worksheets for practitioners and several tables that simplify and focus users' attention on key concepts and processes. The main document is supplemented by a set of appendices ("tool tabs") with more specific information for best practice in evaluation including a long list of potential indicators and guidance for assessments that involve Indigenous communities.

Weaknesses

Although the Ecosystem Services Toolkit contains guidance and tools for evaluating ecosystem services, it does not contain significant guidance on integrating climate considerations into the analysis. In addition, the toolkit, produced by Biodiversity Canada, is specific to Canada and its ecosystems. Considerations for services provided by Canadian ecosystems are likely to differ significantly from tropical ecosystems and may preclude some components of this toolkit from supporting cost-benefit analysis in LAC. A final weakness is that the toolkit is focused on identifying benefits of ecosystem services but does not provide substantial guidance on potential costs.

Application to New Toolkit Development

While geographically specific and focused on benefits, the Ecosystem Services Toolkit is a systematic and well-organized resource with characteristics that should be incorporated in future toolkit development including:

- A clear, stepwise framework with subsections that guide practitioners through analysis.
- Attention to tables, graphics, and call-out boxes that bring attention to key information and direct users through steps of the framework.
- Additional detailed information provided through references to external resources and directly linked guidance worksheets.
- Guidance for NbS across multiple geographical scales.

Table 5. Sample table from Ecosystem Service Assessment for Decision-Making - Examples of ecosystem services questions for identifying proposed Nature-based Solutions impacts alongside recommended tools for analysis of each question and type of impact

Example Questions	Potential Types of Analyses and Tools
Are temperate grasslands known to contribute to flood regulation?	• Literature review of grasslands, flood control • Expert consultation with local/regional grasslands ecologists, hydrologists
How will housing development in a specific area impact any ES benefits?	• Screen tool to identify relevant ES • Stakeholder consultations to elicit values associated with focal ES • Modelling or scenarios of changes to ES and benefits from alternative housing • Risk analysis • Cost-benefit analysis • Municipal development plans
What is the optimal location for a new protected area for the greatest benefits for both biodiversity and ES?	• Spatial mapping of multiple ES and biodiversity indicators (participatory and data driven) • Bundle analysis • Interviews, surveys, and/or focus groups with local communities
Can agricultural production in the area of interest remain sustainable in the face of important drivers of change in the region?	• Statistical analysis of trends in drivers of change (e.g., climate change, demographic change, global markets) • Statistical analysis of condition and trends in ES that support and regulate food production (e.g., soil and water ES, pest control) • Modelling of driver impacts on focal ES, food production quantities, input costs, and prices • Scenario exercises • Workshops with local farmers
Should natural or man-made infrastructure be used to increase water quality?	• Determine which indicators of water quality are most relevant to local communities • Modelling analysis of how watershed contributes to water quality • Economic valuation of ES contributing to increased water quality • Cost-benefit analysis of watershed management approach versus built infrastructure

Targeted Scenario Analysis: A New Approach to Capturing and Representing Ecosystem Service Values for Decision-making

UNDP 2013

Available at: https://www.cbd.int/financial/values/undp-scenarioanalysis.pdf

Overview

The UNDP Target Scenario Analysis builds on traditional cost-benefit analysis and emphasizes presenting evidence for decision-makers. The guidebook frames this approach in economic terms as neutrally identifying trade-offs between Business-As-Usual (BAU) options versus Sustainable Ecosystem Management (SEM). Users are guided through the process of designing and implementing a sector-specific, stakeholder-informed Targeted Scenario Analysis from defining the baseline, intervention, and purpose of the analysis to making recommendations based on the projected BAU and SEM scenarios. Although not specifically written for NbS, this resource discusses the implications of adaptative practices for evaluating uncertainty in projections. This guidebook breaks down the complicated task of developing and comparing projections of project costs and benefits using practical examples, critical considerations, and straightforward explanation of complicated concepts.

Strengths

One of the unique features of this toolkit is the extent to which it discusses the baseline, or BAU, scenario. Most of the reviewed toolkits did not compare a project to an alternative without a project; they simply compared the costs and benefits of the project alone. The toolkit also emphasizes the importance of considering both benefits and costs of NbS, arguing that without balanced consideration of the costs, analysis of benefits is not as robust.

The toolkit includes a sophisticated discussion of the importance of establishing causality when assessing an intervention. Identifying causality requires demonstrating that the intervention is responsible for causing the observed effects. Firm evidence that a project is responsible for the results supports the case for investment in the project or future investments. This guidebook also distinctly specifies the importance of carefully incorporating stakeholder perspectives in the analysis through participation, as well as seeking and applying expert knowledge.

Weaknesses

In some ways, the unique strengths of this resource also make it a more difficult toolkit to apply. Developing a full BAU projection in addition to a complete cost-benefit analysis of the NbS requires

extensive resources beyond a simple project cost-benefit analysis. Additionally, this toolkit is broadly applicable without providing guidance for a particular type of NbS, and therefore may not meet the needs of practitioners looking for information on assessing the costs and benefits of NbS. Although the guidebook discuses criteria for selecting and applying useful indicators, it lacks detail or examples of what indicators are commonly included or may be applicable to NbS.

The guidebook is also vague on how to obtain estimates for the indicators included in scenario projection, which is a complicated, resource-intensive process worth substantial guidance.

Application to New Toolkit Development

The Targeted Scenario Analysis Guidebook presents a distinct approach to project analysis with features worth replicating including:

- Incorporating balanced considerations of the project benefits and costs relative to baseline, e.g. with a BAU projection.
- Encouraging active participation of stakeholders, consultation with subject experts, and engagement with relevant literature.
- Identifying what type of evidence would be convincing to policymakers deciding whether or not to invest in a project.
- Managing and incorporating uncertainty and causality into cost-benefit analysis.

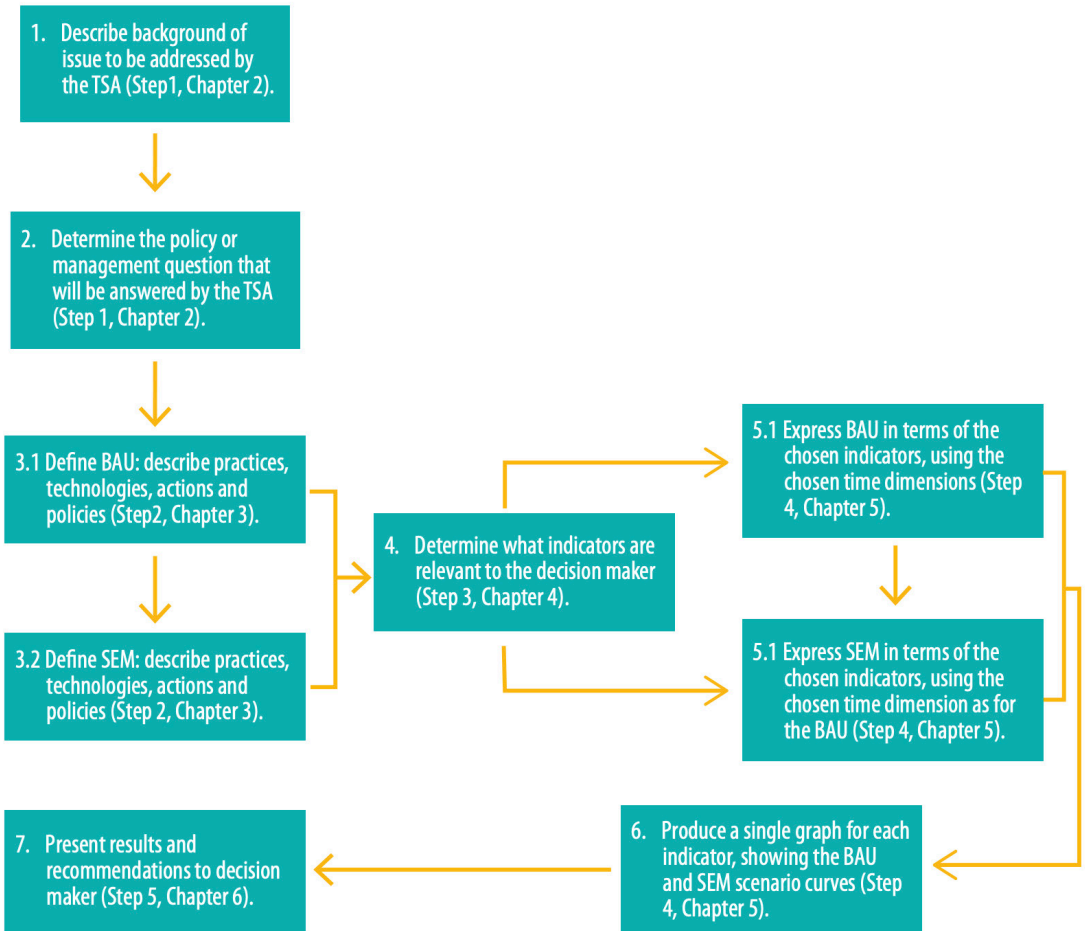
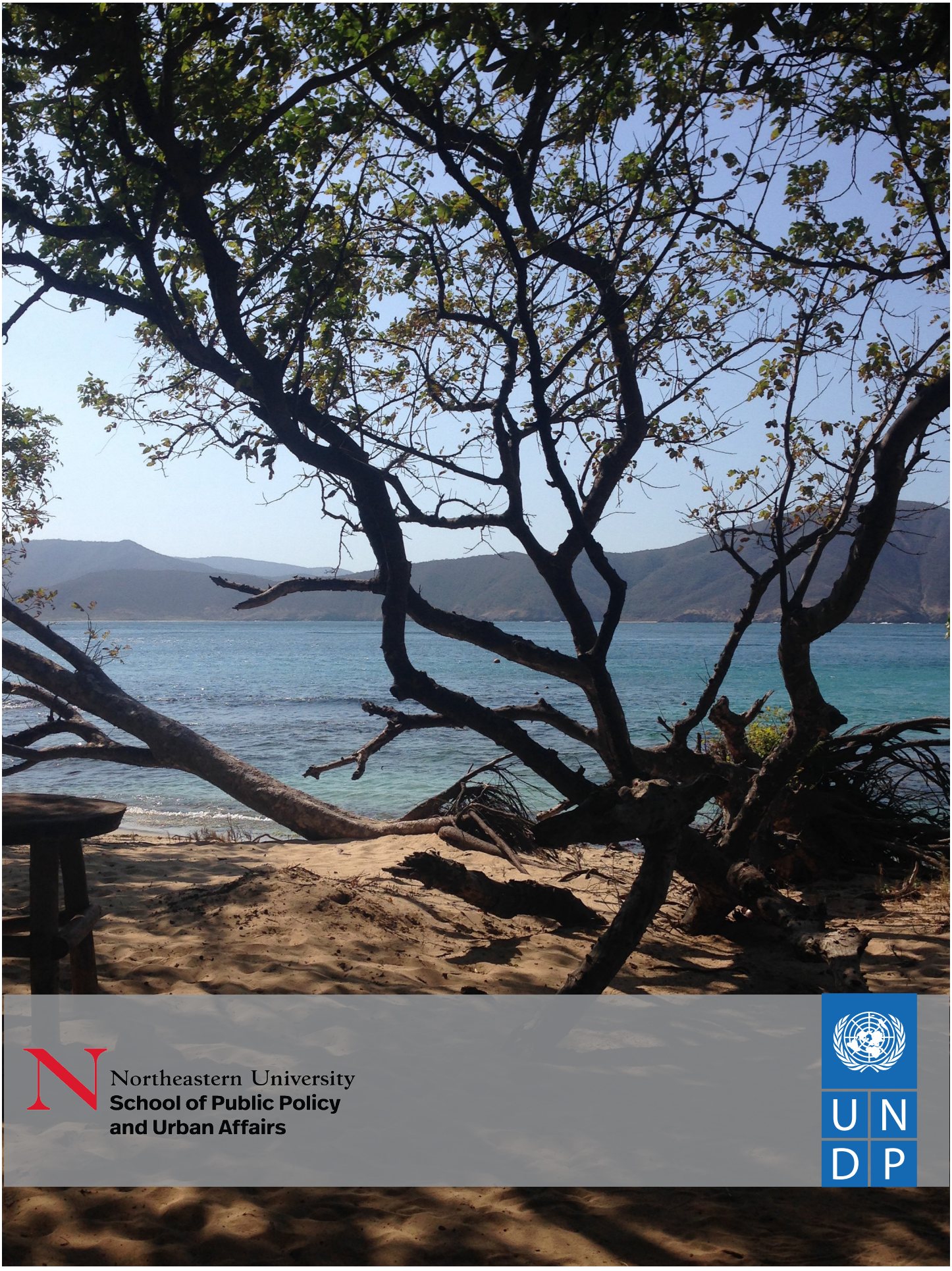


Figure 7. Recommended process and decision chart for targeted scenario analysis of Nature-based Solutions



Northeastern University
School of Public Policy
and Urban Affairs

UNDP