BRANTAS RIVER, JAVA, INDONESIA ©Subardi Agan/Shutterstock.com

INDONESIA

SUSTAINABLE ASSET VALUATION (SAVI): FOREST RESTORATION IN THE BRANTAS RIVER BASIN, INDONESIA – MAINTAINING AND ENHANCING WATER YIELD THROUGH LAND AND FOREST REHABILITATION

2022

The **Sustainable Infrastructure Tool Navigator**

is an online platform that connects infrastructure practitioners with over 100+ relevant tools that can assist them in evaluating and making decisions at various phases of the infrastructure life cycle. This case study demonstrates the use of a tool in a country context, to better understand the process involved as well as good practices, challenges and lessons learned.

SUSTAINABLE ASSET VALUATION (SAVI)

SAVi (https://www.iisd.org/savi/) is an assessment methodology that provides policymakers and investors with a comprehensive analysis of how much their infrastructure projects and portfolios will cost throughout their life cycles, taking account of risks that are overlooked in a traditional valuation.

SAVi uses a combination of system dynamics and project finance modelling to capture the full costs of environmental, social, economic and governance risks. Moreover, SAVi calculates the dollar value of externalities that result from infrastructure development.

Policymakers and investors can therefore use SAVi to make investment decisions that are not only based on a holistic valuation of risks, but also on the extent to which their investments will contribute to fulfilling national development priorities, curbing climate change and addressing its effects, and achieving the United Nations Sustainable Development Goals. Policymakers and investors can thus use SAVi to steer capital toward sustainable infrastructure.

1. BACKGROUND

In the Brantas River Basin on the island of Java in Indonesia, deforestation for farming is degrading the land. The agriculture sector is an essential source of income for local communities and employs about 40% of the country's labour force (Indonesia Investments 2022). However, it contributes to environmental issues such as soil erosion, loss of biodiversity and decreased water retention. In addition, the conversion of natural landscapes to development has made floods more severe, reduced groundwater recharge, and aggravated downstream water scarcity during the dry season. Climate change and land degradation are expected to worsen both floods and droughts in the Indonesian region if no action is taken.

To address these problems, multiple partners – including the Indonesian Ministry of Environment and Forestry, the United Nations Industrial Development Organization (UNIDO), and PT Multi Bintang, a local subsidiary of the Heineken beverage company – joined forces and developed the "Maintaining and Enhancing Water Yield through Land and Forest Rehabilitation" (MEWLAFOR) project. Funded mainly by the Global Environment Facility (GEF) and the MAVA Foundation under the Nature-Based Infrastructure (NBI) Global Resource Centre, the project aims to restore degraded land in the Brantas River catchment. It will implement agroforestry systems – including planting trees on degraded land – on 387 hectares, creating 150 hectares of bamboo plantations, and bringing 26,033 hectares under improved management. To further improve water retention, the project includes constructing 600 absorption wells (two metres x two metres) and 8,000 biopori holes[1] (one metre deep x 10 cm across) (International Institute for Sustainable Development 2021a; Global Environment Facility 2022).

The reforestation, agroforestry and water retention measures are examples of NBI that can provide valuable infrastructure services. NBI includes a variety of natural ecosystems or working landscapes that can be conserved, rehabilitated and maintained to enhance capabilities and reduce the necessity for grey infrastructure, such as wetlands that retain and filter water, and coastal mangroves that protect communities from floods and wave energy. Ultimately, the project will benefit 278,600 people and address priorities related to land restoration and watershed management that are part of Indonesia's National Medium-Term Development Plan 2020-2024 (Global Environment Facility 2022).

The International Institute for Sustainable Development (IISD) used the Sustainable Asset Valuation (SAVi) methodology to analyse the MEWLAFOR project, as part of more than 40 assessments for IISD's NBI Global Resource Centre. The assessment aimed to quantify the ecosystem services of the reforestation initiative and water retention wells, economic impacts, and co-benefits (See Table 1). The MEWLAFOR project is currently under preparation. The GEF approved the initial concept in early 2021; the full project

1 Biopori holes are a natural way to prevent flooding and enrich soils.

proposal has now been submitted and incorporates the results of the SAVi assessment. SAVi has also helped the project's proponents better understand the influence of climate impacts on the performance of infrastructure investments and to compare nature-based and grey-build infrastructure alternatives (IISD 2022a).

2. SAVI AS A SIMULATION METHODOLOGY TO VALUE RISKS AND EXTERNALITIES

SAVi is a simulation methodology that helps governments and investors value the many risks and externalities that affect the financial performance of infrastructure projects and the delivery of infrastructure services and additional benefits. The customized assessments combine robust science, systems thinking and financial valuations.

The core features of SAVi are:

- **Valuation:** SAVi values, in financial terms, the environmental, social and economic risks and externalities of infrastructure projects. These variables are ignored in traditional financial analyses.
- **Simulation:** SAVi combines the results of systems thinking and system dynamics simulation with project finance modelling. Engagement with asset owners and local stakeholders helps define relevant risks and simulation scenarios.
- **Customization:** The SAVi valuations are customized to each project by working with asset owners and stakeholders to identify the local project context, uncertainties and unique dynamics.

3. APPLICATION OF SAVI TO THE MEWLAFOR PROJECT – THE PROCESS

Experts from IISD and UNIDO collaborated closely throughout the SAVi process. They identified the MEWLAFOR project's impacts and chose relevant indicators for the assessment. UNIDO gathered key data for the analysis from project partners PT Multi Bintang and the Indonesian Ministry of Environment and Forestry. IISD verified the project data provided, and complemented this with additional research.

The whole SAVi assessment, from initial engagement to presentation of results (see figure 1), took about six months.

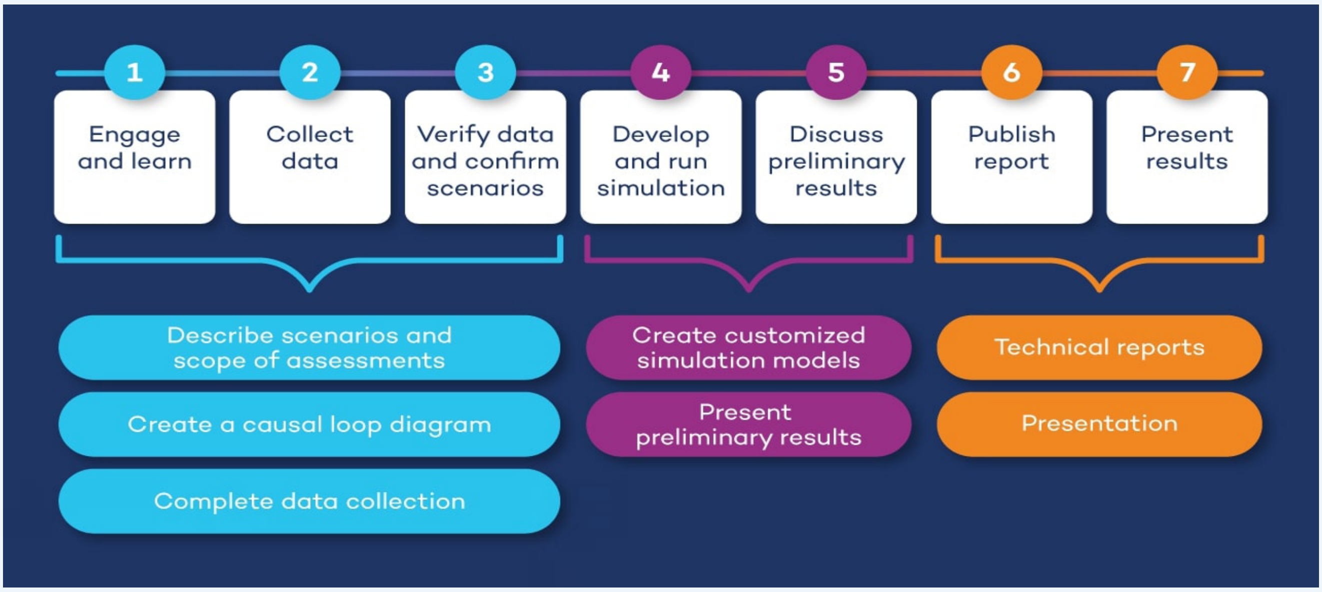

FIGURE 1: STEPS AND OUTPUTS OF A SAVI VALUATION

Source: IISD 2021a

The MEWLAFOR assessment combined system dynamics and project finance modelling with spatial analysis and world-class climate data. As one of the first steps of the assessment, IISD developed a causal loop diagram (CLD), an analytical tool that captures the dynamics of a system (Figure 2). By illustrating the connections between socio-economic and environmental indicators, the CLD exposes the potential impacts of the MEWLAFOR project on the socio-ecological system. The customized simulation model for the project includes variables such as the area of agricultural and forested land, precipitation and water retention, flood risks and damage, income from agroforestry, industry and bamboo production, and carbon storage and groundwater availability. For example, the diagram shows how forested land delivers infrastructure services like increased water retention and reduced flood risk (R2 - R7), which means less damage to agroforestry systems during flood events. This increases productivity and income, so there is less demand for agricultural land and, therefore, a further decrease in deforestation (IISD 2021b).

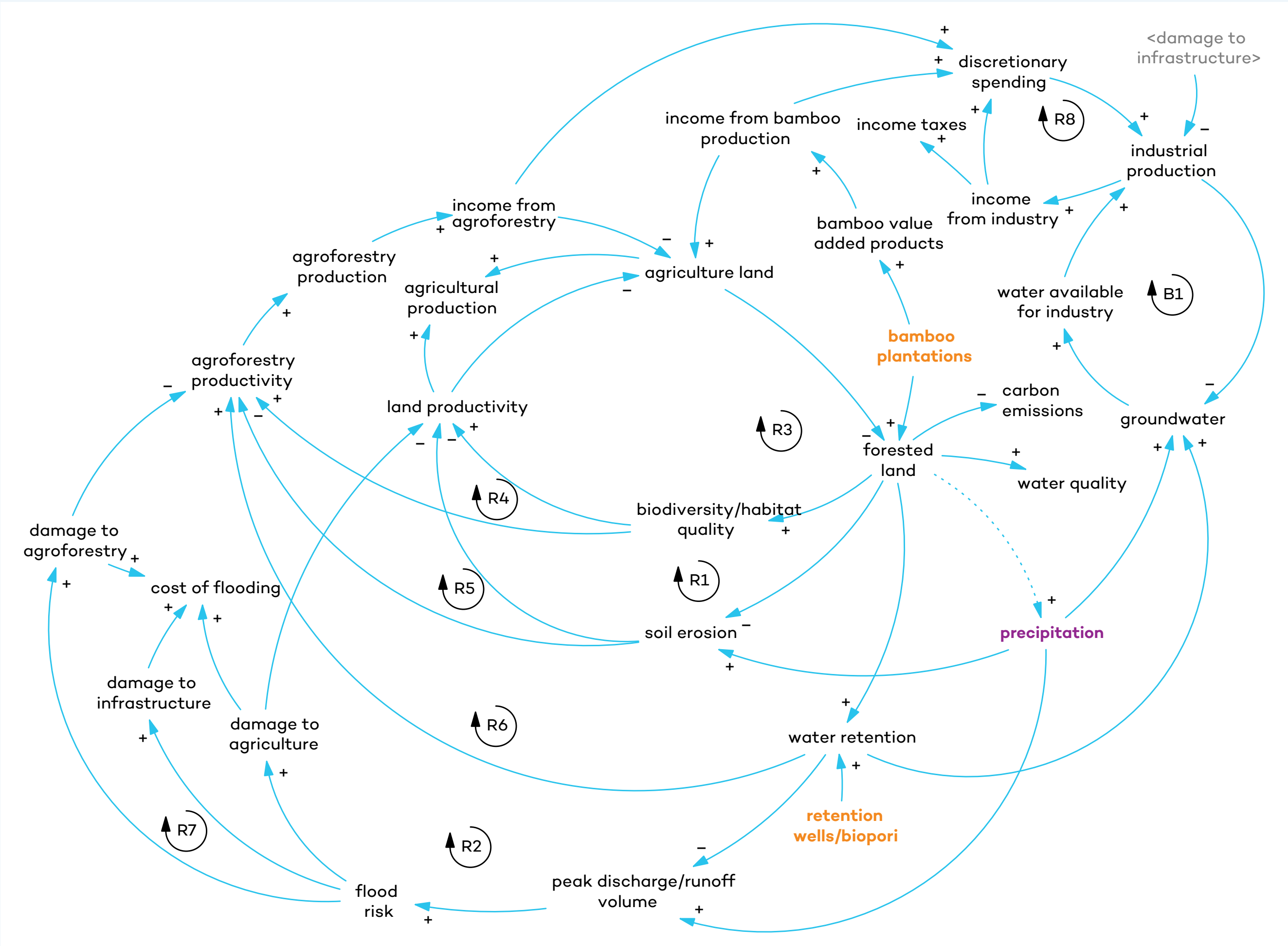

FIGURE 2: CAUSAL LOOP DIAGRAM. VARIABLES DISPLAYED IN PINK ARE CLIMATE INPUTS [2]

Note and source: Variables displayed in orange are proposed policy actions. These interventions can reverse the vicious cycles of deforestation and create more sustainable sources of income (IISD 2021b).

2 A "**+**" sign implies that the two variables change in the same direction. For example, more land productivity leads to more agricultural production.
A "**–**" sign implies that the two variables change in opposing directions. An increase in one leads to a decrease in the other, and vice versa. For example, more damage to agriculture leads to less land productivity, and higher land productivity means that less land is needed for agriculture.
R stands for "Reinforcing loops" that tend to increase and amplify the interconnexion in the system. Reinforcing loops represent growth processes, hence dynamics that cause exponential growth or decline. For example, an increase in births leads to an increase in population, which in turn leads to a higher number of births. In isolation, this loop triggers exponential growth.
B stands for "Balancing loops" which represent a self-limiting process, which aims at finding balance and equilibrium. For example, an increase in population increases the number of deaths, which leads to a decrease in population (◊ balancing process).
See full explanation: https://nbi.iisd.org/wp-content/uploads/2022/01/savi-brantas-river-basin-indonesia.pdf

A spatially explicit analysis was used to quantify ecosystem services from the MEWLAFOR project. The analysis compared how land restoration or continued deforestation both influence carbon storage, water pollution, and water and sediment retention. IISD then conducted an integrated cost-benefit analysis (CBA) that estimated the benefits and costs of the improved land management, the construction of the retention wells, and biopori holes. This integrated CBA considered the project performance under two climate change scenarios (RCP 4.5 and RCP 8.5)[3].

An additional financial analysis addressed the change in prices over time, the time value of money, and the opportunity costs of the investment. The financial analysis enabled the intervention's net present value (NPV) and internal rate of return (IRR) to be calculated under the different climate scenarios[4] (International Institute for Sustainable Development 2021b).

4. RESULTS

The integrated CBA in Table 1, below, forms the backbone of the valuation results. It demonstrates that MEWLAFOR has positive net benefits when considering its financial costs and its externalities. Over 20 years, the MEWLAFOR project will generate net benefits between US$104.34 million and US$131.59 million. This makes it more cost-effective than building a traditional reservoir for storing water (a typical "grey" solution), and it provides significant societal benefits like carbon storage and agroforestry income.

Additionally, by avoiding deforestation and planting new trees, the project can generate a carbon storage benefit of nearly $32 million within 20 to 30 years. Such carbon payments alone could be greater than the project costs of about $9.6 million. The assessment thus underlines and strengthens the idea that carbon payments can play a key role in mobilizing investments in NBI in Indonesia, and other similar regions.

The SAVi assessment also demonstrates that investing in improved land and water management can avoid between $79.09 million and $759.93 million in damage from floods, erosion and nutrient pollution. By incorporating world-class climate data into the valuation, SAVi helps users understand the climate adaptation benefits of NBI.

3 RCP 4.5 and 8.5 are two climate change scenarios. Representative Concentration Pathway (RCP) 4.5 assumes that emissions peak in 2040. RCP 8.5 assumes continued high reliance on fossil fuel-based energy.

4 Net Present Value (NPV): The difference between the present value of cash inflows net of financing costs and the present value of cash outflows. It is used to analyse the profitability of a projected investment or project. Internal Rate of Return (IRR): An indicator of the profitability prospects of a potential investment. The IRR is the discount rate that makes the net present value of all cash flows from a particular project equal to zero. https://nbi.iisd.org/wp-content/uploads/2022/01/savi-brantas-river-basin-indonesia.pdf

TABLE 1: INTEGRATED COST-BENEFIT ANALYSIS (UNDISCOUNTED AND UNINFLATED) [5]

	20-year lifetime (2021–2040)		30-year lifetime (2021–2050)	
	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Added benefits				
Value of bamboo exports	0.21	0.21	0.35	0.35
Value of agroforestry benefits	2.12	2.12	3.35	3.35
Tree planting wages	0.52	0.52	0.52	0.52
Carbon storage benefit	31.99	31.99	31.99	31.99
TOTAL ADDED BENEFITS	**34.84**	**34.84**	**36.21**	**36.21**
Avoided costs				
Avoided flood damage to households	24.00	24.53	486.79	77.96
Avoided flood damage to agriculture	12.06	14.00	193.73	36.90
Avoided erosion damage to agriculture	17.85	42.64	41.65	52.56
Avoided nitrogen pollution	17.10	17.10	25.65	25.65
Avoided phosphorus pollution	8.08	8.08	12.12	12.12
TOTAL AVOIDED COSTS	**79.09**	**106.34**	**759.93**	**205.1**
Investment and maintenance costs				
Improved land management investment cost	8.94	8.94	8.94	8.94
Absorption wells and biopori investment cost	0.56	0.56	0.56	0.56
Annual maintenance costs	0.10	0.10	0.14	0.14
TOTAL COSTS	**9.60**	**9.60**	**9.64**	**9.64**
NET BENEFITS	**104.34**	**131.59**	**786.50**	**231.75**
BENEFIT-TO-COST RATIO	**11.87**	**14.71**	**82.56**	**25.03**

Net benefits are positive and increase with greater climate variability. All values are in million US$ (2020). Numbers in italics are dependent on the climate scenario. Net benefits are equal to avoided costs plus added benefits minus investment costs.

5 For a complete explanation of the assessment performed and the different scenarios see the full report: https://nbi.iisd.org/wp-content/uploads/2022/01/savi-brantas-river-basin-indonesia.pdf

TABLE 2: NET PRESENT VALUE AND INTERNAL RATE OF RETURN FOR ALL SCENARIOS [6]

Lifetime of project	20-year lifetime (2021–2040)		30-year lifetime (2021–2050)	
Climate scenario	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
S-NPV	63,539	71,551	208,593	92,259
S-IRR	62.8%	74.8%	62.9%	74.8%
S-NPV (excluding carbon benefit)	41,850	49,861	186,903	70,569
S-IRR (excluding carbon benefit)	56.5%	69.5%	56.6%	69.5%
NPV (excluding carbon benefit and avoided costs)	-8,330	-8,330	-8,136	-8,136
IRR (excluding carbon benefit and avoided costs)	-11.0%	-11.0%	-4.8%	-4.8%

S-NPV and S-IRR include added benefits, avoided costs, and investment and maintenance costs. SAVi also calculates S-NPV and S-IRR excluding the carbon benefit and a conventional NPV and IRR that do not include the carbon benefit or the intangible avoided costs. All values are in US$ thousand (2020).

Based on the results in Table 1 and Table 2:

- The MEWLAFOR project has positive net benefits that far exceed the costs when externalities are considered.

The carbon benefits and the avoided costs are what make the project economically viable for investors and investment-worthy for society. This is what is demonstrated in the benefit-to-cost ratios (table 1) and the S-NPV and S-IRR that treat the carbon benefit and externalities as revenues (table 2). Where those carbon benefits and avoided costs are excluded (last two lines, table 2), the NPV and IRR remain negative.

The SAVi valuation of the MEWLAFOR project has two main limitations. First, the integrated cost-benefit analysis comprises the impacts on society in general without differentiating between who pays and who benefits. The benefits and avoided costs – such as avoided flood and erosion damage, income from agroforestry, and improved water quality – benefit various actors, but no individual stakeholder group will reap all the benefits or avoid all the costs. This may limit the incentives for individual actors to invest in NBI, as the benefit in most cases can likely be viewed as a “common good”. Therefore, multi-actor collaboration is highly recommended.

Secondly, the assessment could not quantify the downstream impacts of the Brantas River on the project due to a lack of data. A complete analysis of water management in the Brantas River Basin should consider the entire watershed for a more comprehensive picture. This limitation suggests that the valuation conducted might underestimate the net benefits of the project (IISD 2021b).

5. LESSONS LEARNED

Despite its limitations, there were positive lessons from the assessment. Close collaboration between various stakeholders was a key success factor in this SAVi valuation. As described above, the engagement between IISD, UNIDO and local projects partners PT Multi Bintang and the Indonesian Ministry of Environment and Forestry provided crucial data and helped customize the SAVi valuation to the local context. The assessment also benefited from diligent project preparation documents that had been developed for funding applications. The MEWLAFOR project also demonstrates that close cooperation of different public and private stakeholders is a critical factor for successful NBI project funding and development.

The SAVi valuation showed that the MEWLAFOR project only appears economically viable when direct economic impacts, as well as externalities, are considered. To mobilize funding for NBI, it is key to integrate avoided costs and added benefits into financial analyses. Crucially, climate impacts such as extreme rainfall can greatly influence the financial performance of infrastructure investments and must not be overlooked in assessments.

6 For a complete explanation of the assessment performed and the different scenarios see the full report https://nbi.iisd.org/wp-content/uploads/2022/01/savi-brantas-river-basin-indonesia.pdf

Investments in reforestation and improved water management offer significant benefits to the Brantas River Basin. Scaling up similar NBI in Indonesia and around the world could foster greater climate resilience and support sustainable livelihoods. Infrastructure planners and decision-makers should embrace the potential of NBI to address multiple challenges cost-effectively.

6. REPLICABILITY

SAVi valuations need to be customized to the specific project, as it is a tool for asset-specific valuations. Modelling the dynamics that are relevant to the local context and using as much location-specific and project-specific data as possible will provide the most accurate results.

SAVi is available for diverse types of infrastructure including transportation, energy, water, and buildings.[7] It can inform different stages of the infrastructure life cycle, from strategic planning and project preparation to ex post evaluation.

Data availability is a challenge, and collecting and verifying data and results requires considerable time and resources. However, based on the country context and level of development, additional resources and subsidies could potentially be available to project teams interested in applying SAVi. Under the NBI Centre, IISD will undertake more than 40 valuations over the next four years. Interested stakeholders can submit projects for valuation at https://nbi.iisd.org/submit-your-project/.

IISD is continuously updating a public database about the performance of NBI to address this challenge (IISD 2022c).

KEY INSIGHTS

> The SAVi assessment shows that nature can provide cost-effective infrastructure services (such as flood protection and water provision) and support climate adaptation.

> The SAVi assessment demonstrates the value of a multi-stakeholder approach to addressing land degradation and water management. It shows that carbon pricing can make these types of projects attractive to investors.

> Integrated valuation can support efforts to scale up restoration in the Brantas River Basin of Indonesia to address land degradation and water scarcity issues.

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7 For an overview of all projects and sectors see https://www.iisd.org/savi/projects/

REFERENCES

Global Environment Facility (2022). Maintaining and Enhancing Water Yield through Land and Forest Rehabilitation (MEWLAFOR). https://www.thegef.org/project/maintaining-and-enhancing-water-yield-through-land-and-forest-rehabilitation-mewlafor. (Accessed on 8 August 2022).

Indonesia Investments (2022). Pertanian di Indonesia. https://www.indonesia-investments.com/id/budaya/ekonomi/ikhtisar-struktur-ekonomi/pertanian/item378. (Accessed on 8 August 2022).

International Institute for Sustainable Development (2021a). The Nature-Based Infrastructure Global Resource Centre. https://www.iisd.org/projects/nature-based-infrastructure-climate. (Accessed on 8 August 2022).

International Institute for Sustainable Development (2021b). *Sustainable Asset Valuation (SAVi) of Forest Restoration in the Brantas River Basin, Indonesia*. https://nbi.iisd.org/wp-content/uploads/2022/01/savi-brantas-river-basin-indonesia.pdf. (Accessed on 8 August 2022).

International Institute for Sustainable Development (2022a). Methodology for NBI valuations: https://nbi.iisd.org/methodology/. (Accessed on 8 August 2022).

International Institute for Sustainable Development (2022b). Online Training Course About Nature-Based Infrastructure. https://nbi.iisd.org/online-training-course-about-nature-based-infrastructure/. (Accessed on 8 August 2022).

International Institute for Sustainable Development (2022c). Database. https://nbi.iisd.org/database/. (Accessed on 8 August 2022).