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Framework for Planning and Evaluation of Nature-Based Solutions for Water in Peri-Urban Areas

Ana Paula Morais de Lima [1], Aline F. Rodrigues [1,2], Agnieszka Ewa Latawiec [1,2,3,4,*], Viviane Dib [1], Fernanda D. Gomes [1], Veronica Maioli [1], Ingrid Pena [1], Fernanda Tubenchlak [1], Alanna J. Rebelo [5,6], Karen J. Esler [6], Amy M. P. Oen [7], Nancy Andrea Ramírez-Agudelo [8], Elisabeth Roca Bosch [8], Nandita Singh [9], Lina Suleiman [10] and Sarah E. Hale [7]

1 International Institute for Sustainability, R. Dona Castorina 124, Rio de Janeiro 22460-320, Brazil; anapaulamoraisdelima.iis@gmail.com (A.P.M.d.L.); a.rodrigues@iis-rio.org (A.F.R.); v.dib@iis-rio.org (V.D.); f.gomes@iis-rio.org (F.D.G.); v.maioli@iis-rio.org (V.M.); ingrid.pena@gmail.com (I.P.); f.tubenchlak@iis-rio.org (F.T.)
2 Department of Geography and Environment, Rio Conservation and Sustainability Science Centre, Pontifical Catholic University of Rio de Janeiro, R. Marquês de São Vicente, 225-Gávea, Rio de Janeiro 22451-000, Brazil
3 Department of Production Engineering, Logistics and Applied Computer Science, Faculty of Production and Power Engineering, Agricultural University Kraków, ul. Balicka, 116b, 30-149 Kraków, Poland
4 Faculty of Mechanical Engineering, Opole University of Technology, Mikołajczyka 5, 45-271 Opole, Poland
5 Institute of Soil Climate and Water, Natural Resources and Engineering, Agricultural Research Council, P.O. Box 8783, Pretoria 0001, South Africa; arebelo@sun.ac.za or rebeloa@arc.agric.za
6 Department of Conservation Ecology & Entomology, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa; kje@sun.ac.za
7 Norwegian Geotechnical Institute (NGI), Ullevål Stadion, P.O. Box 3930, N-0806 Oslo, Norway; amy.oen@ngi.no (A.M.P.O.); sarah.hale@ngi.no (S.E.H.)
8 Institute for Sustainability Science and Technology, Universitat Politècnica de Catalunya, Jordi Girona 1-3, 08034 Barcelona, Spain; andrea.ramirez.agudelo@upc.edu (N.A.R.-A.); elisabet.roca@upc.edu (E.R.B.)
9 School of Natural Sciences, Technology and Environmental Studies, Södertörn University, 141 89 Stockholm, Sweden; nandita.singh@sh.se
10 Department of Urban Planning and Environment, School of Architecture and the Built Environment, KTH, Royal Institute of Technology, 114 28 Stockholm, Sweden; lina.suleiman@abe.kth.se
* Correspondence: a.latawiec@iis-rio.org or alatawiec@gmail.com

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Abstract: Recent efforts to achieve social, economic, and environmental goals related to sustainability emphasize the importance of nature-based solutions (NBS), as grey infrastructure alone is insufficient to address current challenges. The majority of frameworks proposed in the literature fail to address the full potential of NBS, neglecting long-term results, unintended consequences, co-benefits, and their contribution to achieving global environmental agreements, such as the Agenda 2030, especially for water management in a peri-urban context. Here we present an innovative framework that can be applied to both NBS project planning and evaluation for several water-based challenges, giving practitioners and researchers a tool not only to evaluate ongoing projects but also to guide new ones. The framework considers three main stages of a NBS project: (1) context assessment, (2) NBS implementation and adaptation process, and (3) NBS results. This tool has the potential to be used to evaluate whether NBS projects are aligned with sustainability dimensions through a set of adaptable sustainability indicators. The framework can also highlight how the NBS targets are related to the sustainable development goals (SGD) and contribute to catalyzing the 2030 Agenda. The framework is an important tool for water management and other NBS types.

Keywords: sustainability indicators; sustainable development goals; NBS monitoring; NBS implementation

1. Introduction

Worldwide degradation of natural resources drives the need for innovative approaches to overcome socio-economic and environmental challenges [1]. Nature-based solutions

(NBS) may provide a holistic approach to support conservation and sustainable development, encompassing concepts such as green infrastructure (GI), ecosystem-based adaptation (EBA), ecosystem-based mitigation (EBM), and resilience [2–4]. Despite the differences between existing definitions, most of them emphasize the need to find a balance between social, economic, and environmental targets, which is also the basis of the concept of sustainability. In general, the definitions of NBS highlight the importance of the long-term sustainability of NBS [4] and the generation of multiple co-benefits, increasing socio-ecological system resilience and constructing a more sustainable society [4–6]. The NBS approach can also catalyze the sustainable development goals (SDGs) established for urgent global action [7].

The European Commission (2015) define NBS as: "actions that are inspired and supported by nature, which are cost-effective and simultaneously provide social, economic, and environmental benefits and help build resilience" [2]. This concept was adopted in this paper. The concept of NBS emerges from the ecosystem management and conservation approach underlying the Convention on Biological Diversity (CBD) for the management and adaptation to climate change and biodiversity loss. It has been increasingly cited in scientific literature and government and non-government programs and policies [3,6,8,9]. The implementation of NBS must be based on technical and scientific discussions and must draw on traditional and empirical knowledge as all these factors contribute to guiding the use of natural resources [1,10]. It is also important to involve different stakeholders in decision-making processes and the assessment of NBS effectiveness [1,11], considering their experience and knowledge related to the identification of problems, perceptions, and solutions [8,12].

Based on the multitude of different NBS definitions and the application of NBS on the ground, the International Union for Conservation of Nature (IUCN) established a standard definition through a framework to design and verify NBS, aiming to improve and give consistency to this process [13]. In addition, several frameworks have been proposed in the literature to quantify and highlight the (co)benefits of NBS [14]. However, most of them aimed to evaluate the potential benefits of future interventions, and there are few frameworks that have been published to assess NBS that already have been implemented [6,14]. Existing frameworks do not often capture the multiple impacts of NBS, such as co-benefits and unintended consequences, and do not include an integrated assessment for decision making [15]. Therefore, it is necessary to develop frameworks that can capture comprehensive approaches for NBS, considering them as processes and identifying long-term results [16], as well as being able to assess the potential multi-dimensional effectiveness of NBS through a participatory approach. Furthermore, previous NBS frameworks have often focused on the urban context [17], with little attention to rural or peri-urban areas. The peri-urban concept differs across countries and regions [18]. However, despite the differences, there are similar concepts related to peri-urban as peripheries, suburbs, sprawls, and territories in between, among others [18,19]. Peri-urban areas are multi-functional landscapes with place-based and social dynamics that differ from rural and urban territories. They are strategically relevant to ecosystem services (ES) due to their proximity to built-up areas and natural habitats [20]. However, peri-urban spaces often have small populations (numerically compared with urban spaces); therefore, finance and governance are weaker than in the large urban hubs [21]. There are a few frameworks that have presented a set of related indicators that can be used to construct a detailed assessment scheme. Such frameworks include those proposed by Cohen-Shacham et al. 2019 [1] and Watkin et al. 2019 [14]. The indicators in these frameworks provide a means to identify progress towards outcomes or impacts. However, they can vary greatly depending on the context in which the framework is applied [22]. Frameworks associated with indicators should have flexible structures so that they can be applied in different socio-spatial contexts.

This study presents a transdisciplinary effort to elaborate an operational NBS framework that addresses gaps in previous frameworks. A systematic review was carried out to identify particulars of existing frameworks in relation to the SDGs, relation to three sustainability dimensions, flexibility to be applied in different contexts, type of place (focus on urban, rural, peri-urban, or both), and flexibility to be applied in different contexts. The results of this analysis were used as the basis to produce a new framework complimentary to work already carried out and to fill gaps that previous frameworks have not considered. The framework can also be used to highlight how the NBS targets are related to the SDGs and contribute to catalyzing the 2030 Agenda [7]. The framework considers three main stages: (1) Context assessment, (2) NBS implementation and adaptation process, and (3) NBS results (including co-benefits and impacts on human well-being). In addition, a list of indicators to evaluate or guide the assessment of the three sustainability dimensions is proposed. The list of indicators presented here is based on a Brazilian NBS case study related to water challenges in a peri-urban area [23]. However, the categories used in the framework may be applied to other contexts, and the indicators adjusted as such. The framework is a tool to evaluate past NBS projects and to plan future ones, considering the planning cycle phases of a project while allowing methods for verification, comparison, and measurement of effectiveness using indicators.

2. Materials and Methods

2.1. Framework Scope and Content

To develop the framework scope and content, a systematic literature review, workshops, and meetings with a transdisciplinary team from the academic, private, and public sectors were conducted. The systematic literature review was carried out using Web of Science, Scopus, and Scielo databases, where "nature-based solutions" (the acronym NBS was not used) AND "framework" were used as keywords. Using nature-based solution as a keyword may not result in all literature being captured; however, since the focus of the framework was on evaluating co-benefits, which is unique to the definition of NBS, including NBS as a keyword was justified. Content written in English, and published until March 2020, was used. Articles on NBS that proposed a novel framework and/or applied it to a case study/studies were selected. Additionally, to enhance the review, snowball sampling of the references cited in the selected publications that included key articles was used (Figure 1).

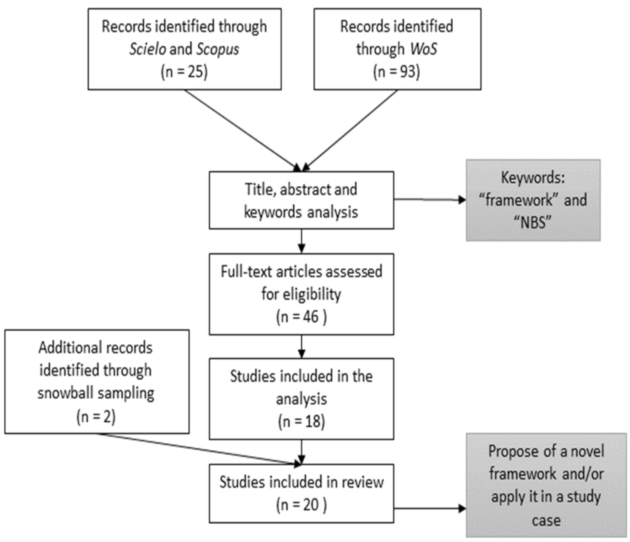

Figure 1. Flow diagram of the systematic literature review process.

The following information from the selected publications was extracted: year of publication, keywords, settlement type (urban, peri-urban, rural, or general), type of approach (conceptual, practical, or both), links to the SDGs (if mentioned in the framework), sustainability dimension addressed (environmental, social and economic,) if the framework proposed a qualitative or quantitative assessment and the purpose of the framework concerning NBS (planning, evaluation, or both) (Table S1). The resulting systematic literature review table is described in the supplementary material (Table S2). Based on the systematic literature review, the main concepts related to NBS, the main themes included, and main gaps were identified. These were included in the framework developed here.

2.2. Framework Construction Process

The framework was developed between January and July 2020 by a transdisciplinary team with varying backgrounds during a series of 20 meetings and three international workshops with more than 18 participants from seven countries. The work was carried out in collaboration with a team of international experts who refined and validated consecutive drafts of the framework (Figure 2).

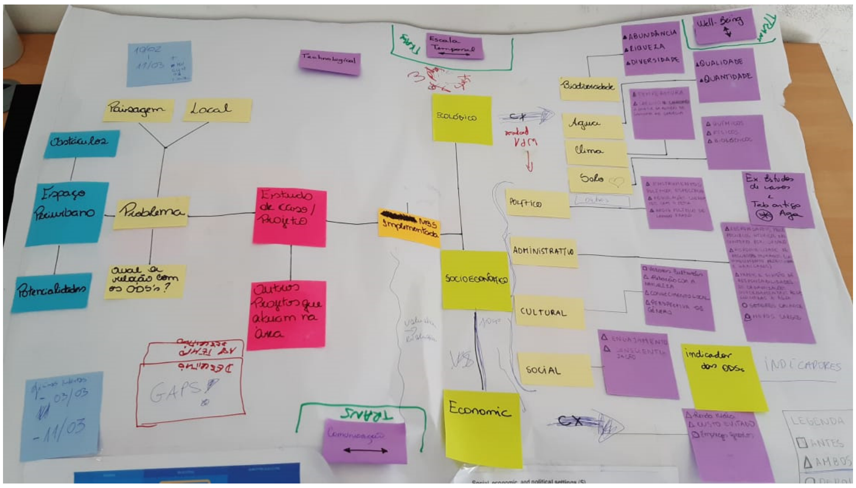

Figure 2. Draft of the framework as a result of a workshop.

The timeline of the meetings and workshops, along with details of the framework construction process, can be found in the Table S3 and Figures S1 and S2. As the topic of nature-based solutions is a sustainability issue, the experts worked together to construct the conceptualization of the framework, by linking their different backgrounds (sustainabilityscience, geography, biology, engineering, tourism, social communication, and environmental science, among others).

By taking into consideration differences between peri-urban areas in different countries and regions [18], the international team of experts constructed an overall framework. This framework can be used in different contexts, as well as in areas that are not peri-urban. The first stage of the framework allows the threats and opportunities of each case study to be identified as well as defining the problem to be tackled and its scale.

The framework stages propose to detail the theory of change of each nature-based solution, from the design of objectives, their relationship with the implementation of the solution, and its short, medium, and long-term results.

2.3. Sustainability Indicators

Based on the definition of sustainability that considers environmental, economic, and social aspects in the long term, we proposed a list of sustainability indicators aligned to the operational framework. To this end, recent literature on sustainability indicators was analyzed, and an iterative process of consultations with international experts was performed. The theory of change approach (ToC) [22,24] was adopted to categorize the indicators into process-based and result-based indicators. The ToC is one of the most robust frameworks for projects because it is well-suited for designing, monitoring, and evaluating complex and long-term interventions where transformative change is expected [22]. The ToC can be used to probe reasons as to how and why a change is driven, initiated, and supported in a particular context. The process-based indicators provide information about the planning, designing, and implementation of the NBS interventions, while the result-based indicators measure their effectiveness [22].

Practical examples of indicators for each category of the framework were proposed based on lessons learned from the project "Water and Forest Producers". It is essential to highlight that this list is an example of how indicators can be related to the different categories of the framework and how to organize them according to the theory of change classification adopted here. New and/or different indicators will be needed for different projects and case study analyses.

The water and Forest Producers project aims to conserve and restore riparian forests in Rio de Janeiro (Brazil) to improve water quality and quantity as an alternative to conventional solutions. The Guandu Watershed—where the project takes place—is a vital source of drinking water for eight million people in the city [23]. An overview of the project is presented in SM5.

3. Results

3.1. Systematic Literature Review

There were 18 articles that met the criteria of our systematic literature review and two more articles that were added from snowball sampling, resulting in a database with 20 publications (Figure 1). Most articles were published in 2019 (n = 8), followed by articles published in 2020 (n = 5), 2017 (n = 4) and 2018 (n = 3). There was no initial search date limit, and the first framework related to NBS was published in 2017, demonstrating the novelty of this research field [6]. The articles were categorized as "conceptual" papers where the frameworks were not applied in practice (n = 8) and "practical" papers where a case study/experience related to the application of the framework was presented (n = 4). Eight articles addressed both conceptual and practical NBS framework aspects. Regarding the place, or settlement type, where the analyzed frameworks can be applied, nine were general (can be applied to any context), eight were applicable to an urban context, and two were applicable to a rural context. There were no studies that explicitly considered a "peri-urban" area.

Of the three pillars of sustainability, environmental and social dimensions (n = 20 and n = 19, respectively) were used in more frameworks than the economic dimension (n = 10). Most of the frameworks (n = 16) did not refer to the SDGs. Of the four articles that did refer to SDGs, only two clarified which one (s): SDG 11 (Sustainable cities and communities) [8], SDG 2 (zero hunger), SDG 3 (good health and well-being), SDG 4 (quality education), SDG 10 (reduced inequalities), SDG 11 (sustainable cities and communities), SDG 12 (responsible consumption and production), SDG 13 (climate action) and SDG 14 (life on land) [25].

Most of the frameworks found in the literature addressed the benefits and issues of NBS qualitatively (n = 10), while four addressed the benefits quantitatively and six used both. The frameworks were designed for planning (seven studies), evaluation (seven), for both planning and evaluation (five) of the NBS, and there was one framework that was not designed for planning or evaluation (more information can be found in the Supplementary Materials Tables S1 and S2).

3.2. Framework Structure

The result of these processes was two frameworks defined as (i) an operational framework structuring each of the steps, linking spatial context with NBS implementation, results, and adjustments (Figure 3); and (ii) a conceptual framework—a simplified version of the framework aimed to reach a broader audience (Figure 4).

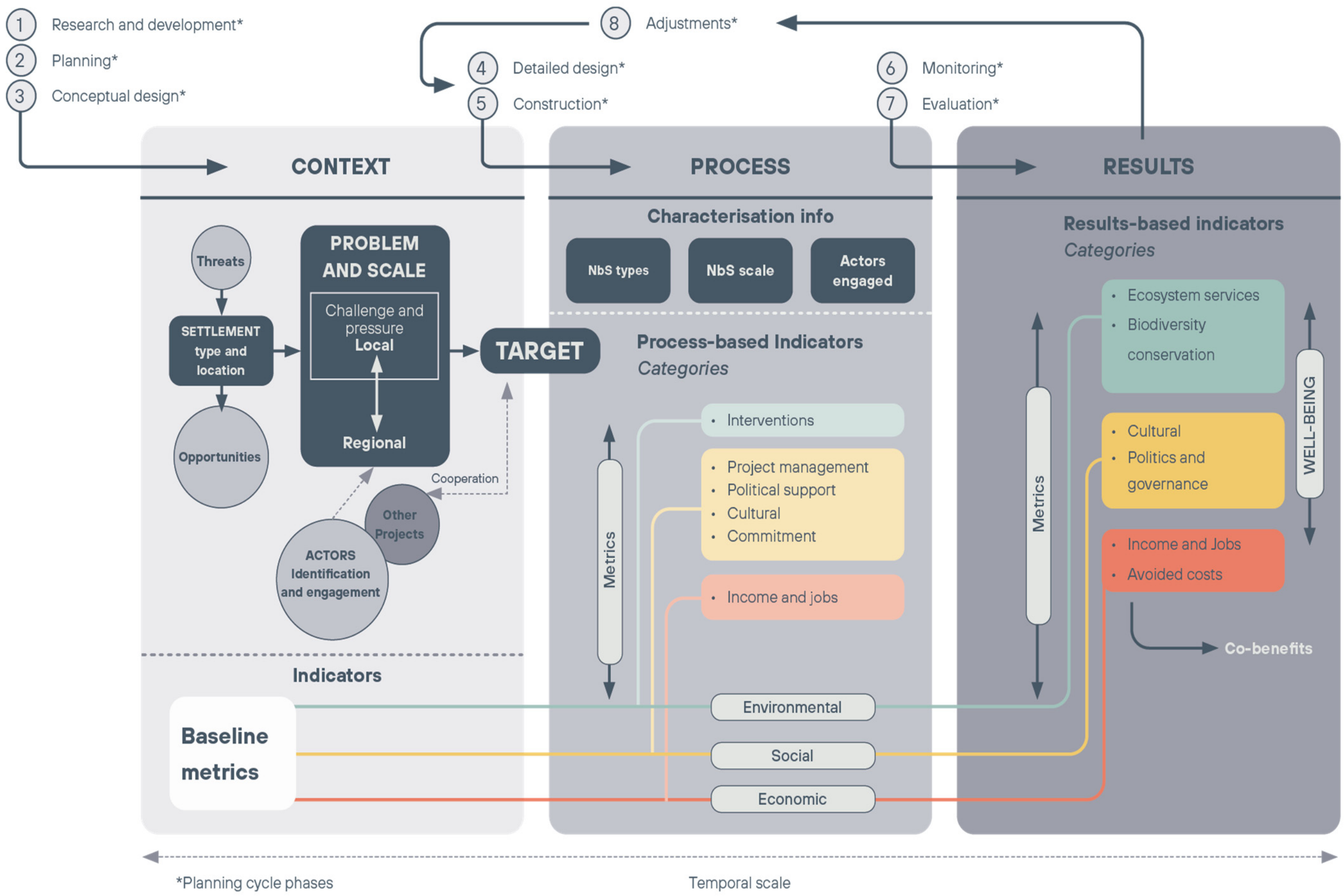

Figure 3. The Operational Framework. The first panel in light gray contextualizes the CONTEXT of the NBS project. Boxes inside it denote three aspects of the project: spatial location (SETTLEMENT), central question the NBS will be used to solve (PROBLEM AND SCALE), and the specific goals addressed (TARGET). Circles denote drivers and other elements related to these aspects; solid arrows denote influence between elements, and dotted arrows denote links that are acknowledged as important. The black arrow on the top indicates the three first phases of the planning cycle. The second panel in gray represents the PROCESS of NBS implementation. That is, where the NBS adopted is characterized by its type, scale and actors engaged. Here the dimensions and categories of the PROCESS INDICATORS are represented. Colored boxes denote the three sustainable development dimensions (ENVIRONMENTAL, SOCIAL, and ECONOMIC). The black arrow on the top indicates the fourth and fifth phases of the planning cycle. The number in circles indicates the sequence of the phases. The last panel in dark grey represents the project's RESULTS, which encompass OUTCOMES and IMPACTS indicators. Again, colored boxes denote the three sustainable development dimensions. The vertical white arrow denotes that all indicators must aim at human WELL-BEING as the ultimate goal. CO-BENEFITS denote a positive part of the unintended consequences of the NBS. The black arrow on the top indicates the sixth and seventh phases of the planning cycle. The evaluation process leads to an improved NBS application, highlighted here by the last phase of the planning cycle (the ADJUSTMENTS), linking the results panel to the stage of design and construction of the NBS. The dotted arrow at the bottom denotes the temporal scale and indicates that the framework can be used both retrospectively and prospectively.

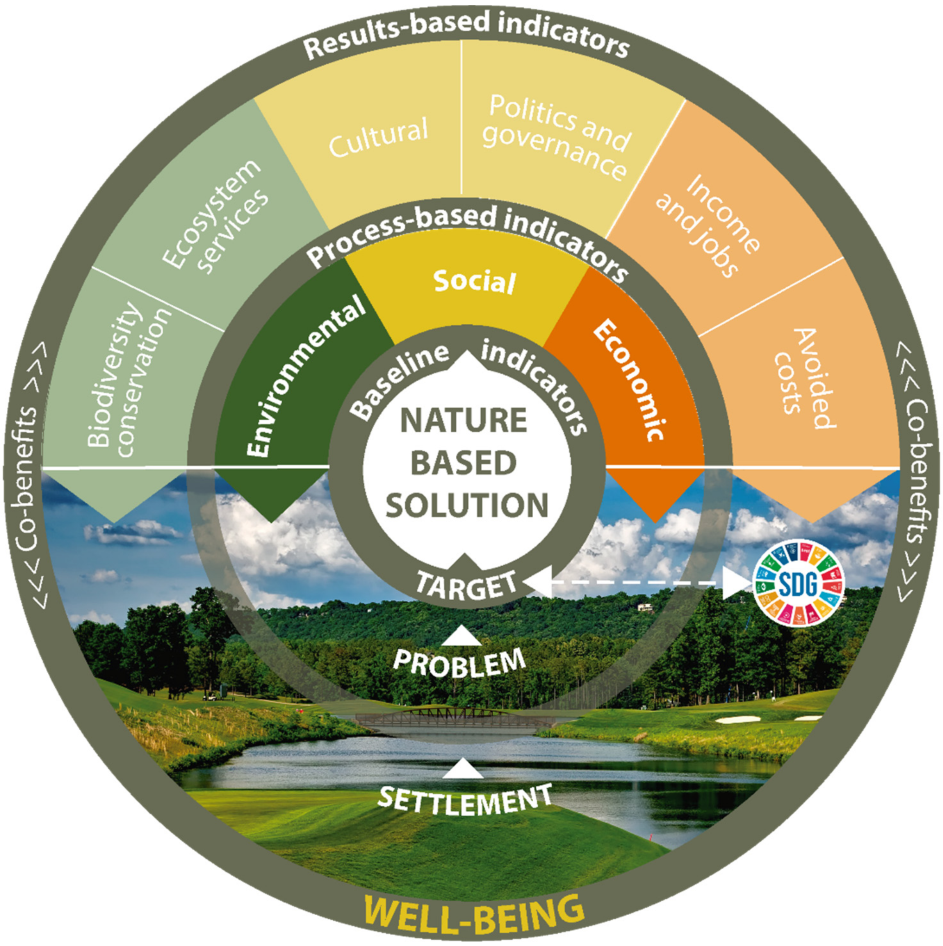

Figure 4. The Conceptual Framework. The context is characterized by the SETTLEMENT, represented by a landscape image, with forest, water body, and human elements shown at the bottom of the figure. It is the baseline for the PROBLEM identification and the TARGET to be addressed by the NATURE-BASED SOLUTION, signalized with a sequence of white arrows. A dotted arrow indicates the TARGET's association with the SUSTAINABLE DEVELOPMENT GOALS. From the center of the figure towards the top, the three stages of the NBS are evaluated according to their respective indicators, represented by three gray arches: BASELINE INDICATORS at the spatial context level; PROCESS-BASED INDICATORS, at the process level and RESULTS-BASED INDICATORS at the results level. PROCESS INDICATORS are divided into three dimensions: ENVIRONMENTAL, SOCIAL, and ECONOMIC, represented in different dark colors. RESULTS-BASED INDICATORS are divided into six categories represented in a lighter version of the color of their respective dimension: BIODIVERSITY CONSERVATION and ECOSYSTEM SERVICES within the ENVIRONMENTAL dimension; CULTURAL and POLITICS AND GOVERNANCE, within the SOCIAL dimension, and INCOME AND JOBS and AVOIDED COSTS within the ECONOMIC dimension. The CO-BENEFITS, generated from these results, signalized in the laterals of the external circle, converge into the WELL-BEING of the SETTLEMENTS's habitants, as marked at the bottom of the figure. Source: Background image is from: https://www.pexels.com/photo/bridge-clouds-club-countryside-209982/ (accessed on 10 May 2020).

The operational framework (Figure 3) details all the qualitative information, such as stakeholders, NBS type, NBS scale and steps, context assessment, process, and results, that is used. It also includes categories of indicators that can be used as a tool to assess whether environmental, social, and economic dimensions are well represented or not. The specific set of indicators used in the framework must be selected/constructed on a case-by-case basis. Thus, apart from capturing project progress and effectiveness, monitoring of these indicators reveals if the NBS is aligned with sustainability dimensions or not. The set of indicators should be divided into process-based indicators and results-based indicators. The conceptual framework summarizes the main concepts and stages of this process into a visual guide of the operational framework.

The framework considers three main stages: (1) context assessment; (2) NBS implementation and adaptation process; and (3) NBS results (assessment of outcomes, co-benefits, and impacts on human well-being). This structure applies to both versions of the framework, the operational and the conceptual (Figures 3 and 4, respectively). The first stage refers to the context assessment in which the NBS is implemented, referred to as the settlement, in which the problem is identified and targets defined, and their linkages with the SDGs highlighted. The first box is essential to identify peri-urban characteristics. Identifying the context is the natural starting point for any NBS project. In cases where the NBS is already implemented, a characterization of the context will allow links between the current state of the NBS and the location where it is implemented to be established. This contextualization is an essential step for proposing a suitable NBS, and where initial measurements of the proposed indicators should be made, creating a baseline for later evaluations. The second stage refers to the NBS implementation process, where process-based indicators, inputs, and outputs, may be used to evaluate the NBS. The input indicators may be used to assess the project interventions and activities; thus, they quantify and qualify the resources invested in the project. The output indicators may be used to describe and quantify the short-term results produced directly by the NBS interventions. Process-based indicators should encompass: (i) NBS interventions (environmental dimension); (ii) project management, political support, cultural or educational awareness, and commitment (social dimension); and (iii) income and jobs created (economic dimension). The third stage refers to the NBS results, where results-based indicators may be used to evaluate the sustainability of NBS. Result-based indicators are classified into outcomes and impacts. Outcome indicators provide information about the results of the implemented activities in the medium- to long-term. Impact indicators provide information about the wider long-term results and changes promoted by the interventions (directly or indirectly, intentionally, or unintentionally), including co-benefits and unintended results (or "side effects" of the NBS as the interventions can improve aspects other than the target issue or generate some trade-off) [22]. The concept of co-benefits can be defined as "the positive effects that a policy or measure aimed at one objective might have on other objectives, irrespective of the net effect on overall social welfare" [26].

Result-based indicators encompass: (i) biodiversity conservation and ecosystem services (environmental dimension); (ii) cultural, politics, and governance (social dimension); and (iii) income and jobs and avoided costs (economic dimension). The dimensions, categories, and examples of process and result-based indicators are summarized in Table 1. A comprehensive (but non-exhaustive) list of sustainability indicators is shown in the supplementary information (Table S4), based on the "Water and Forest Producers" NBS project [23] (Figures S3–S5).

Tasks related to research, planning, and conceptual development, must be carried out before the implementation, along with a description of the spatial context. At this stage, it is important to identify the main opportunities and threats related to the settlement and the main problem (i.e., the socio-environmental challenges and pressures in the area). To improve understanding of the problem, one could identify its impacts on local and regional scales (when applicable) since the challenges that are addressed through NBS are usually larger than the project itself is able to address. Next, it is important to set specific targets for the NBS project, recognizing that NBS might not meet all the needs [27]; while at the same time analyzing the links with the SDGs. Finally, the identification of local actors and other projects taking place within the region is critical to establishing partnerships and improving the results while fostering transdisciplinary [28].

Table 1. Sustainability indicators structure and examples.

Type	Dimension	Category	Examples
Process-based indicators	Environmental	Interventions	Number of trees seedlings planted
	Social	Project Management	Number of people participating in the NBS project
		Political Support	Number of laws and policies developed or reformed
		Cultural awareness or education	Incorporation of cultural values and perceptions
		Commitment	Continuous participation in the NBS process
	Economic	Income and Jobs	Number of jobs created directly
Result-based indicators *	Environmental	Provisioning ecosystem services	Streamflow
		Regulation and maintenance ecosystem services	Erosion prevention
		Socio-cultural ecosystem services	Recreational use of green spaces
		Biodiversity conservation	Biodiversity index
	Social	Cultural	Local perception of environmental improvements
		Politics and governance	Improvements/adjustments to existing laws
	Economic	Income and jobs	Property betterment
		Avoided costs	Water treatment avoided costs

* Result-based indicators must also be measured before the NBS implementation, as a baseline.

Target definition links the first stage (context assessment) with the next (the NBS implementation and adaptation processes), where the NBS implementation process is described. Here, it is necessary to describe the NBS, including its type and application scale, and list the actors engaged in the implementation process. This step is critical as the NBS choice must be appropriate to fulfill the targets. Here, the categories of indicators that should be measured to monitor the implementation process are suggested. These are related to the short-term impacts of the NBS. The environmental dimension encompasses indicators related to ecological aspects of the environment. The social dimension encompasses indicators related to social and governance aspects of project implementation, such as project management, political support, incorporation of cultural/educational values, and actors' commitment. The economic dimension encompasses indicators related to the economic aspects of project implementation, such as income and jobs created during the process of NBS implementation.

The third stage (results-based indicators) of the framework is dedicated to assessing the NBS results and co-benefits. Here, another set of indicators that reflect the project's outcomes and the medium to long-term impacts of the NBS is suggested. The environmental dimension encompasses indicators related to ecosystem services and biodiversity conservation. The social dimension encompasses indicators related to politics, governance, and cultural aspects. The economic dimension encompasses indicators related to livelihood enhancement, income, jobs, and other kinds of economic benefits derived directly, as well as avoided costs resulting from the NBS implementation (e.g., in a case where the NBS aims to improve water quality, there are avoided costs with water treatment, as the water is improved with NBS). As mentioned above, NBS practitioners should attempt to measure a baseline for the results-based indicators to compare the scenarios before and after the NBS implementation. This need is highlighted in the first phase as "baseline indicators". Furthermore, this baseline could provide valuable information for other stakeholders to enable monitoring, evaluation, and adaptive management. In cases where a NBS project does not measure a baseline, it is very difficult to identify the impacts of the implemented actions. The baseline provides a critical reference for comparing the situation before and after the interventions [22]. Thus, it is essential to identify the social, economic, and environmental situation before a NBS implementation to track changes over time. The impacts can be short-, medium-, and long-term and should be evaluated based on adequate indicators.

3.3. Guide to Apply the Framework

Figure 5 shows a step-by-step scheme to assist practitioners when they apply the framework.

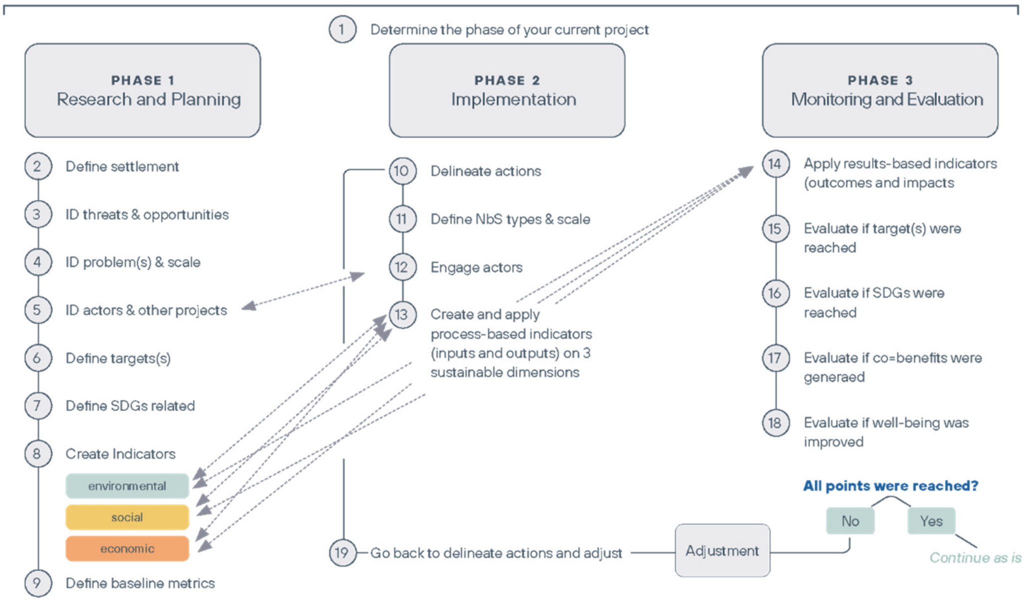

Figure 5. Framework guide step by step.

The first step (1) is to identify the NBS project phase. It is important to note that even if the project is ongoing, the information required in the previous steps will allow gaps and inconsistencies to be identified. The second step (2) consists of settlement definition and a description of the peri-urban area. In addition, it is necessary to identify threats and opportunities at the site, the problem addressed by the NBS, and its scale (4). In the research and planning phase, it is also necessary to identify/map actors and other projects related to the problem addressed (5). From the characterization of the site and the problem addressed, as well as the related stakeholders, it is necessary to establish the targets (6) and identify how the NBS is aligned with the SDGs (7). After targets have been defined, indicators (8) that can support the monitoring of the baseline, the process of implementation, and the results of the NBS, should be identified. This exercise can start in the first phase and be improved in the second phase (13). The indicators defined must be aligned with each sustainability dimension (environmental, economic, and social). The next step is to define baseline metrics (9), the indicators that will be used to measure the state of local conditions before NBS, allowing comparison with results after NBS results.

The second phase of the framework is related to NBS design and implementation. In this phase, the first step (10) is to delineate the project actions to achieve the targets. In addition, it is necessary to define the NBS type and scale (11). The NBS type and scale must be coherent with the problem and its scale (4). The next step is to engage actors (12). Process indicators must be created/applied in this phase (13) in order to monitor inputs and outputs (following the theory of change classification adopted here).

The first step of the third phase of the framework is to apply results-based indicators (14) (outcomes and impacts) to identify the results in the medium tolong term. From this, it is necessary to evaluate if the targets were reached (15). It is also important to identify the SDG (16) and co-benefits (17) that have been achieved. Finally, the project must evaluate if overall community well-being was improved (18). This phase also allows for iteration in cases where projects did not meet the goals set as actions can be adjusted (19) aiming to obtain better results.

4. Discussion

A framework to guide NBS planning should define all stages and relevant subcategories related to the design and implementation of a NBS, with more detail being provided at each phase. The framework to assess an implemented NBS should provide the structure to evaluate the process, results, and impacts of the project activities using indicators and qualitative information to monitor the process. Beyond that, the categories of the framework are applicable to the peri-urban of different countries and cities, which allows characterization and analysis of the peri-urban environment.

This framework can be viewed operationally (to be applied to NBS cases-Figure 3) and conceptually (to obtain an overview of what the framework offers—Figure 4). The conceptual framework provides a general picture of the central elements NBS projects should consider and address to accomplish actions that are inspired and supported by nature and simultaneously provide social, economic, and environmental benefits and help build resilience and improve human well-being. The operational framework follows the phases that occur in the planning cycle of a project (Table 2), giving practitioners a tool not only to evaluate ongoing projects but also to guide new ones.

Table 2. Planning cycle phases definitions.

Planning Cycle Phases	Definitions
Research and development	An activity that depends on a specific question or objective. It could be R&D to test solutions in the lab/meso or pilot scale or desk work investigating the site to implement a possible NBS.
Planning	This is a more general term and is related to the planning that is needed for the intervention. It encompasses desktop studies and preliminary investigations to assess a potential intervention(s). It can also include the involvement of stakeholders to check the suggested NBS is viable at the site (feasibility study). It may include a prediction of the expected expenses and the planning of actions for the NBS implementation.
Conceptual design	This is the moment when the urban planners, landscape architects and engineers (among others) with relevant backgrounds make the overarching design of the NBS. This moves the NBS from what is viable to a specific solution (conceptual).
Detailed design	The actual design of the intervention (engineering calculations, models completed) is most often communicated as technical drawings that can be directly used for the construction of the intervention.
Construction	The physical construction of the NBS by those including construction companies, NGOs and local people at the project site.
Monitoring	The process of collecting and analyzing data and information aiming to identify changes in relation to a baseline.
Evaluation	The process of examining the monitoring data to identify the influences/impacts of the project activities and summarize lessons learned.
Adjustments	The process of adjusting project activities to improve results.

The stages clarify the needs of (and adjustment to) the different project phases, from the planning and design to evaluation. The process and results phases of the framework are concentrated on the tripod of sustainability (social, environmental, and economic dimensions) [4,29]. According to the systematic literature review, over half of the frameworks did not include the economic dimension, which is essential when assessing whether a NBS has a preferential cost-benefit ratio when compared to traditional grey infrastructure [28,29]. The economic dimension is also important when assessing whether the NBS had an impact on improving livelihoods, creating jobs and/or promoting financial income, or avoided costs to local stakeholders.

The link between the use of a NBS and the social, economic, and environmental benefits provided as well as the way in which the NBS can help to build resilience, is aligned to the goals and targets of sustainable development stated by the Agenda 2030 [7,30]. Despite this, the link between NBS and Agenda 2030 is rarely discussed in existing frameworks presented in the literature. By making the link in this framework, the role of NBS projects as powerful tools for achieving the SDGs is recognized. There are some enablers that can catalyze the achievement of SDGs in relation to NBS, for example, mainstreaming nature into decision making, building multi-stakeholder partnerships, and strengthening good governance [30]. The framework proposed here considers all these points, making it possible to identify links with the SDGs for specific NBS projects as well as understand how the NBS can catalyze the achievement of the NBS. Human well-being is highlighted as one of the main goals of NBS projects, where results converge.

By including the sustainability dimensions in the framework, it is possible that input data from a project can be categorized, and the dimension(s) receiving more focus or weight can be identified as well as areas for further development to ensure full sustainability is achieved (also known as all dimensions included) [31]. The process and results stages of the operational framework contain some categories related to sustainability dimensions that are applicable under any context, varying only in the indicators that are related to them. The categories highlight the main issues that have to be considered throughout the project.

The instrument guiding the assessment of the sustainability dimensions is the sustainability indicators list—a set of indicators related to each category that can be used to assess or monitor the representativeness, success, or effectiveness of a particular activity categorized in one of the three dimensions of the project. Based on the ToC [32,33], the indicators list is both problem and NBS-type-oriented, thus adaptable to any project. In this work, some examples of indicators from the Forest and Water Producers project in Brazil are provided (Table S4). However, the way the indicators are organized and classified (i.e., the structure of the list) can be adapted by practitioners, thus, allowing flexibility in the evaluation of sustainability dimensions in any context. The monitoring of process-based indicators can capture the 'project's progress, help to identify barriers, and introduce correctives, while result-based indicators can provide valuable information about the changes promoted by the NBS and guide practitioners when making adjustments if necessary [22,24], as well as compiling lessons learned from the process of change throughout NBS implementation. This structure allows NBS practitioners to identify, monitor, and communicate the changes promoted by the project in short-, medium-, and long-term. In addition, the framework allows for the identification (through impact assessment) and management of unexpected results over time. During the Water and Forest Producer project in Brazil (Figures S3–S5), an unexpected impact was observed, which was the diversification of producers' income through different activities such as bird watching tourism [22]. The impact indicators make it possible to follow the wider long-term changes promoted by the interventions, whether directly or indirectly, intentionally or unintentionally [22]. As a project applies the assessment indicators, it is also possible to identify which dimensions of sustainability are considered most in the NBS and/or are most impacted by it. This structure is considered an advancement to capture NBS effectiveness, which helps to collect evidence about NBS and provides responses to the cited gap on the instruments and tools needed to successfully implement NBS [12].

Identifying the spatial scale of the problem that is to be addressed by the NBS is a novel element of this framework, and it could be helpful to verify the benefits provided by the implementation of NBS, enumerate potential actors and other projects, and aid comparison of case studies. Furthermore, the scale of the problem might be different from the scale of the solution aimed to be delivered through NBS, and thus, it might not be able to meet all needs [27] but instead point to articulated or hybrid approaches [34]. In this sense, the framework developed here supports monitoring of NBS as a planning cycle process, which has been established as crucial to integrating the spatial scale of the implementation, the scale of the challenge, and the scale of the impacts [16]. This is critical to establish and promote local and even regional partnerships and to encourage the participatory approaches from local stakeholders (once they are identified), including them in the design and implementation of activities. Taking a bottom-up approach is fundamental to ensure the longevity of the implemented NBS, as this approach (i.e., with strong community engagement) allows for the identification of potential problems and the development of mitigation strategies [35].

5. Conclusions

The framework presented here is an important and innovative tool to improve existing NBS and guide the creation of new NBS in a consistent way for sustainable development. The framework has a flexible structure, which expands the possibilities of its application beyond peri-urban areas to different countries, landscapes, and contexts that are poorly addressed. It is intended as a tool to be adopted by local and regional decision-makers and stakeholders involved in NBS construction, implementation, and/or monitoring. Its use could also support monitoring to inform, communicate and promote the involvement of different stakeholders, including civil society, towards engagement with NBS. The list of indicators is a tool for stakeholders that can be used to align their projects with the dimensions of sustainability—a fundamental aspect in achieving the SDGs.

The use of this framework contributes to the commitments of the 2030 Agenda, where NBS have the potential to transform the world through greater social, economic, and environmental justice. Future work is needed to apply and potentially iterate and improve the framework using a variety of case studies. The framework proposed here can be adapted and new indicator categories, as well as additional qualitative information, can be added for each specific context which may improve the framework and its application.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14137952/s1, Table S1: Systematic review spreadsheet (S1); Table S2: Attributes table; Table S3: The timeline of the meetings and workshops as well as steps in the framework construction process; Figures S1 and S2: Workshop of framework construction design; Figures S3–S5: Water and Forest Producer Project; Table S4: Examples of qualitative information and indicators based on the framework structure and classification.

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