






## Article

# A Proposal of a Tool to Assess Psychosocial Benefits of Nature-Based Interventions for Sustainable Built Environment

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**Abstract:** The use of nature-based solutions (NbS) in urban regeneration processes has been demonstrated as a multifunctional solution to increase the resilience of the built environment, contributing to improved environmental quality and health and wellbeing, and providing empowerment to communities facing natural hazards. However, when it comes to the assessment of psychological wellbeing and social benefits, existing evidence is still limited. To contribute to the knowledge of NbS' psychosocial benefits, it is necessary to develop and test assessment tools to contribute to a common NbS monitoring framework. In this paper, we describe the development of a psychosocial benefit assessment tool for nature-based interventions in the urban regeneration processes. This tool has been developed within the framework of the H2020 CLEVER-Cities project through a participatory and co-design process, considering advanced sustainability paradigms, such as Regenerative Sustainability and Sensory Sustainability Science. This tool is structured around two dimensions, (1) perceived health and wellbeing and (2) social benefits, which refer to 13 attributes, assessed through 24 items. The Delphi method was used to validate the assessment tool, in which a multidisciplinary panel of experts participated. The results indicate that it has good face and content validity, concluding with the potential applicability of this tool in different contexts.

**Keywords:** nature-based solutions; co-benefits; perceived health; wellbeing; social cohesion; restorative capacity; regenerative sustainability; urban environment; co-design; Delphi method



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## 1. Introduction

Three-quarters of the population of the European Union live in cities. This urbanization trend will continue in the coming decades, along with its associated environmental and health problems. The limited availability of space for the built environment, urban demographic changes, and cultural diversity also contribute to increased social and urban vulnerability, maximizing inequalities [1].

The Sustainable Development Goals (SDGs) were established in 2015 to respond to these challenges and to provide a framework for more integrated policymaking. The SDGs aim to address socioeconomic needs while protecting the environment and adapting to climate change from a multiscale—local to global—perspective. They include a set of common goals and targets, as well as associated evaluation indicators and metrics [2]. This framework provides an internationally accepted approach for assessing sustainability, with three SDGs focusing explicitly on good health and wellbeing (SDG 3), the reduction in inequalities (SDG 10), and the support of sustainable cities and communities (SDG

11). In addition to the holistic urban sustainability assessment, indicators can be used for evaluating interventions, such as nature-based solutions (NbS) [3].

However, evidence shows a general insufficiency of problem-solving power through sustainability science, since many negative environmental and health impacts persist. This situation has led to a global socio-environmental crisis that demands a transdisciplinary effort for developing a multilevel, comprehensive, and complex vision [4]. The solution may lie in other sustainability paradigms, such as Regenerative Sustainability (RS) and Sensory Sustainability Science (SSS) [5–7].

This document is organized around four main sections. The first section, Literature Review, addresses the state of the art in relation to the benefits of nature-based solutions (NbS), specifically focusing on the psychosocial benefits of NbS. In the second section, Materials and Methods, the conceptual framework of the CLEVER-Cities project is briefly introduced, along with the methodology to define CLEVER-Q. This is followed by the presentation of a proposed tool aimed at evaluating the psychosocial benefits of NbS in urban regeneration processes, as well as its validation process. The third section presents the results of the validation of this tool using the Delphi method. Finally, in the last section, Discussion of Results, the results are discussed in relation to previous literature, highlighting technical and academic contributions, as well as the limits of this research and future perspectives.

## 2. Literature Review

NbS have been used increasingly in recent years to respond to these challenges and improve urban environments. Diverse literature in the field of environmental sustainability reports the positive impacts of NbS on climate mitigation, biodiversity, water quality and requalification of water bodies, adaptation to the impacts of floods and coastal resilience, regulation of the microclimate, and air quality [8], as well as the benefits on economic activity in the area surrounding NbS, such as new economic opportunities and green jobs [9]. In addition to the environmental benefits, it is necessary to consider the health and wellbeing benefits of NbS. Health and wellbeing professionals recommend interdisciplinary and intersectoral actions that enable the provision of—and access to—blue and green elements in order to confront urban challenges and contribute to social cohesion [9].

This perspective places us in the field of the restorative capacity of natural environments to improve people's wellbeing, which deals with the concept of the restorative environment, i.e., environments enhancing or facilitating psychological restoration, and thus contributing to human health and wellbeing [10]. The most influential initiatives on this matter are Attention Restoration Theory (ART), developed by Kaplan and Kaplan [11]; and the Stress Recovery Theory (SRT), postulated by Ulrich et al. [12,13]. ART states that natural environments can restore the cognitive resources that people use in their daily activities. In this theory, the restorative potential of environments, known as “restorativeness”, is defined by four fundamental dimensions, (a) “being away”, a series of perceived characteristics that allow individuals to distance themselves physically or psychologically from concerns that require their directed attention; (b) “extent”, the environmental qualities that invite exploration beyond what is immediately perceived; (c) “fascination”, the perceived characteristics that attract people's attention; and (d) “compatibility”, the perception that the environment is consonant with the goals of the person experiencing it. Meanwhile, the SRT theory postulates that despite its adaptive value, the stress response undermines psychological energy and leads to a negative emotional state. In contrast, a positive affective response to open natural settings enables the individual to recover from fatigue and its negative emotional outcomes.

Although the study of restorative environments has been an object of research interest in recent years, most of these surveys have focused primarily on natural settings (outside of urban areas), such as parks and forests [11,13–15]; however, the restorative experience does not occur solely in natural environments, and nor do all such environments contribute to restoration [16]. Recent studies have explored the restorative capacity of urban envi-

ronments [16,17]. One of them, which defines a psychological restoration tool referring to self-reported emotional status, showed that participants' psychological state improved after spending half an hour in one of two selected urban squares [17]. Visitors showed better cognitive performance and reduced negative effect variables (tension–anxiety, anger–hostility, fatigue, and stress), as well as reporting increased happiness.

The study of the restorative capacity of natural and green urban environments is closely linked to Regenerative Sustainability (RS), the next wave of sustainability [18,19]. RS is based on a holistic worldview and paradigm, integrating recent understandings from science and practice, different ways of knowing, and the inner and outer dimensions of sustainability necessary for systemic transformation [6].

In that sense, isolated actions and/or sectoral policies of limited scope are insufficient for systemic transformation. Rearranging the physical structure of a neighborhood is not simply related to the urban dimension, but also to the economic and sociocultural domains. It is an action that substantially alters the lifestyles, thoughts, and activities of urban dwellers. In that sense, it is necessary to study the patterns of health and wellbeing, considering not only the objective and measurable parameters that characterize urban environments (distribution of uses, functional provisions, scale, density, etc.), but also those qualitative and subjective aspects that assess the personal and social experience derived from each urban habitat [20]. Most authors consider health and wellbeing as a complex and multifactorial construction where self-experience has a significant specific weight [21]. This approach argues that sustainability science needs to become Sensory Sustainability Science (SSS), in which social sciences are particularly relevant to reach a comprehensive understanding of society [5].

The study of the contribution of natural elements to health, wellbeing, and social cohesion is a priority area of study at Horizon Europe for technical research guidance, mainly in relation to quantitative data. This emphasizes the need for a robust methodology to collect these data and share a common vision that generates scientific evidence. Since the last century, the concept of subjective wellbeing indicators has been used as an alternative to classic socioeconomic indicators. Understanding the wellbeing of a person requires measuring cognitive and affective reactions, as well as psychosocial issues, such as social interaction and cohesion, a sense of belonging, or the appropriation capacity of people on interventions [22].

Furthermore, both the EU and UN-Habitat Urban Agenda [1] highlight the potential of NbS to generate place-based improvements in environmental and socioeconomic performance in disadvantaged areas. In these areas, in which there is limited access to urban services, such as green areas, there are greater risks to physical and emotional health, as well as low levels of social cohesion and high levels of perceived insecurity [23,24].

As previously indicated, research on the potential of NbS [25] to increase the resilience of cities and communities against the impacts of climate change is growing, indicating its substantial potential. Among the results of these investigations, there are some reference frameworks, such as MAES [26], EKLIPSE [27], and CITYkeys [28].

A recently published handbook by the European Commission [29,30] for the evaluation of the impacts of NbS introduces a set of indicators collected to evaluate the effectiveness of NbS on the adaptation to—and mitigation of—climate change, as well as their associated benefits. Twelve societal challenges are addressed by this set of indicators, climate resilience; water management; natural and climate hazards; green space management; biodiversity; air quality; place regeneration; knowledge and social capacity building for sustainable urban transformation; participatory planning and governance; social justice and social cohesion; health and wellbeing; and new economic opportunities and green jobs.

Although this handbook contains information and documentation about the impacts or benefits of NbS on climate resilience, water management, natural and climate hazards, biodiversity, and air quality, there are still gaps regarding the impact assessment on health and wellbeing, as well as social issues, such as social cohesion and environmental justice [9,31].

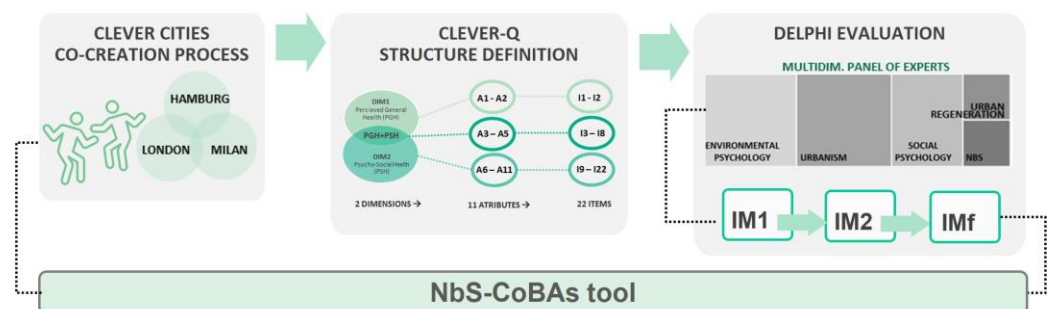
Measuring the impact of NbS based on psychosocial indicators, such as wellbeing or social cohesion, is a complex process in comparison to assessing environmental indicators. At present, the only effective way to measure these dimensions is by using psychosocial surveys and other qualitative research techniques, such as interviews and focus groups, which is not economically feasible in the long term. The statistical offices of local and national governments and EU institutions would have to invest in developing innovative methods and optimized procedures involving, for example, local residents and research organizations in order to gather data in this field in a cost-effective way.

These dimensions of the psychosocial impact of NbS, as well as many of their attributes, appear in the meta-principles and principles of RS. For instance, improvements in human and ecological health and increased wellbeing and happiness are the most important issues for the health meta-principle. The effect meta-principle is associated with a strong sense of place, belonging, collaboration, or co-creation, including multiple subjective and objective points of view. The community culture meta-principle talks about equity (social and environmental justice), inclusivity, diversity, and satisfying livelihoods [6].

To bridge this gap between NbS psychosocial impact assessment needs and existing tools and methods, this work answers to the following research questions: Can a novel tool be proposed to assess NbS' impact on perceived health and wellbeing, as well as on social issues? The outputs and, thus, the academic contribution of this research is the development and validation of a new tool for assessing the impact of NbS on perceived health and wellbeing, as well as on social issues (hereinafter referred to as psychosocial co-benefits—or in short, co-benefits). The presented method is part of a more general tool (CLEVER-Questionnaire, or CLEVER-Qs) that evaluates the impact of the use of NbS in urban regeneration interventions and was developed through a co-creation process. It has to be highlighted that the Delphi method was used to validate the tool, which ensures rigor to the outputs of the tool and enhances the reliability and validity of the findings. This was performed by analyzing the face and content validity of the design of the tool by the application of the Delphi method by a panel of multidisciplinary experts. In summary, this tool fills a need to have valid tools and methods for assessing the impact of NbS and can provide valuable insights for policymakers and urban planners in promoting the use of NbS in urban regeneration projects.

### 3. Materials and Methods

This section introduces (1) the conceptual framework of CLEVER-Cities project; (2) the specific methodology to define CLEVER-Q, where the NbS psychosocial co-benefit assessment tool is integrated and described, including the collaborative process; (3) the proposal for the above-mentioned tool; and (4) the validation process of this tool, along with the Delphi method. Figure 1 summarizes the process under which the NbS psychosocial co-benefit assessment tool was developed.



**Figure 1.** Co-creation process of development and validation of the NbS-CoBAs tool.

#### 3.1. CLEVER-Cities Project Framework

The CLEVER-Cities project <https://clevercities.eu/> (accessed on 20 February 2022) aims at fostering urban regeneration through the implementation of NbS, addressing

urban challenges, and promoting social inclusion. The main goals are to (i) increase and improve local knowledge of NbS, (ii) demonstrate that greener cities work better for people and communities, (iii) contribute with data and information to EU policymaking, and (iv) promote and enable the uptake of NbS in urban planning worldwide. Three cities act as frontrunners, namely London, Hamburg, and Milan, followed by six fellow cities (Malmö, Madrid, Larissa, Sfântu Gheorghe, Belgrade, and Quito).

The urban regeneration challenges covered in the CLEVER-Cities project are:

- Human health and wellbeing: focused on reducing physical, psychological, and physiological stress; damage and negative health impacts resulting from exposure to excessive noise, air pollution, or heat; promoting changes regarding the lack of physical activities; avoiding poor-quality public realm and increasing access to green space.
- Sustainable economic prosperity: centered on reducing poverty rates whilst boosting regional and local value chains by increasing access to job opportunities and encouraging external investments and business start-ups, as well as reducing economic losses related to adverse environmental impacts (e.g., flooding).
- Social cohesion and environmental justice: aimed at enhancing equal distribution and access to environmental facilities (particularly for elderly and excluded social groups), and at strengthening community ties and decision-making processes.
- Citizen security: preventing real and perceived danger and crime in public spaces, reducing and minimizing the social degradation resulting from adverse environmental impacts (e.g., flooding, noise, poor air quality, and excessive heat).

The NbS interventions planned in CLEVER were defined in a co-creation process that ensured participation of all local stakeholders and the whole community. This iterative process usually generates interventions that include not only NbS themselves (greenery of public places, green roofs, and facades), but also activities that contribute to a sense of community around the CLEVER interventions.

The four mentioned challenges are closely related to social aspects and NbS co-benefits, and identifying the social impacts is core for most of the interventions. Key performance indicators (KPIs) were identified by the cities to assess the NbS' effectiveness. Given the lack of standardized KPIs, and in order to assure the alignment of the monitoring strategy in the cities, a questionnaire is proposed as a tool.

### 3.2. CLEVER Questionnaire Development Process

CLEVER revealed that most of the expected outcomes were related to perceived health and wellbeing, sense of belonging, social cohesion, and perceived safety. These expected impacts are mainly linked with social variables, for which questionnaires are very useful tools, as they contribute to assessing the impact of NbS through the perceptions and opinions of people and communities. This is especially relevant for those variables that cannot be directly observed.

The designed questionnaire in CLEVER (CLEVER-Q) included the tool presented in this paper for assessing the health, wellbeing, and social co-benefits of NbS in urban regeneration interventions through the gathering of the users' direct responses.

Once the items or KPIs were defined, an iterative process was performed with the cities' local monitoring teams to select the items of the questionnaire that were more suitable to assess the NbS' impact considering the local context. It was a challenging process that resulted in the definition of a general CLEVER-Q that aimed to be applicable in urban regeneration projects in cities with different expectations regarding social perspective.

To facilitate the answer of the participants, and whenever possible, the questions (items) were grouped within the same answer format and thematic groups of questions. The most used response scale types were the (Dis)Agree scale ("How much you/In what extent do you agree or disagree with following statements?") whose answers can be collected using a 5-point Likert scale from "strongly disagree" to "strongly agree" or with an ordinal scale of 5 points ("strongly disagree", "disagree", "neither agree nor disagree/undecided",



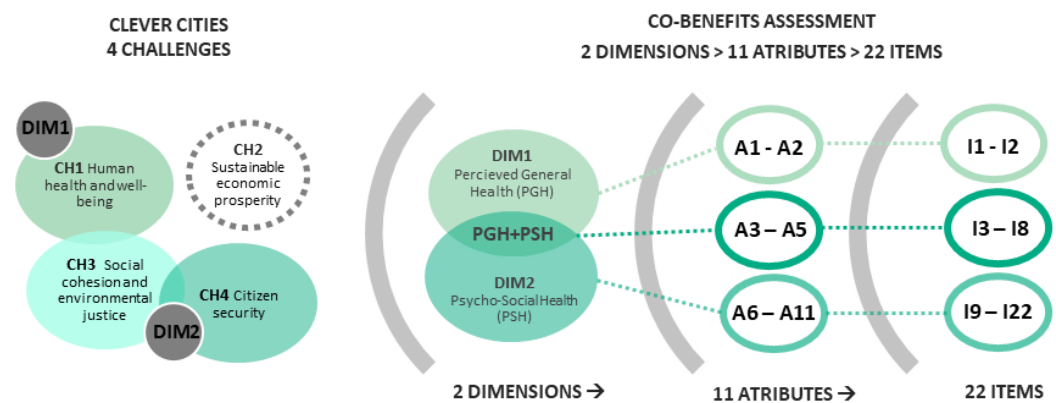
“agree”, “strongly agree”). The other items were measured, where possible, on a 5-point ordinal scale.

The questionnaire was flexible enough to be adapted to the specificities of the place and involved stakeholders. This was relevant in the context of CLEVER, since NbS interventions were tailored to local needs. The urban places of the interventions were the following, open spaces (park, garden, square, lake . . . ), schoolyards and stations (outdoor), buildings (green roofs and/or facades), and local areas or neighborhoods. Five of the nine interventions that required a social impact assessment were related to the NbS open spaces.

### 3.3. Tool for NbS Psychosocial Benefit Assessment

The tool for NbS psychosocial benefit assessment (in short NbS-CoBAs tool) is an innovative tool to assess the types of benefits of NbS in urban regeneration processes, i.e., general health, wellbeing, and social benefits. This is a tool citizen-driven, mainly addressed to the users of urban public spaces, in respect to both their regular habits in terms of where they usually go, and their perception of spaces with NBS aimed to neighborhood regeneration.

Based on the literature, the initial version of NbS-CoBAs tool was structured around 11 attributes. In total, 22 items were selected to measure these attributes in the first version (see Figure 2).



**Figure 2.** Initial version and structure of the NbS-CoBAs tool.

The first dimension is related with NbS’ benefits on general health and wellbeing (Challenge 1 in CLEVER), including attributes, such as perceived general health, subjective wellbeing, restorative capacity, and environmental comfort (acoustic, thermal, lighting, visual, and overall). The second dimension is associated with the NbS’ benefits on psychosocial issues (Challenges 3 and 4 in CLEVER), related to sense of belonging, socio-environmental justice, social cohesion, participation, place satisfaction, and citizen safety.

### 3.4. NbS-CoBAs Tool Validation: Delphi Method

Once the structure of the NbS-CoBAs tool was established and the item statements were prepared, the Delphi technique was used to assess the face and content validity of the tool to measure the psychosocial co-benefits of the NbS.

The Delphi method deals with a systematic and interactive evaluation process in which a panel of independent experts provides anonymous opinions and feedback. It is a flexible method that serves to enrich consensus. In the method, the judgments are summarized and sent again to refine the problem in a varied range of fields [32]. The main characteristics of the Delphi method are anonymity, interaction, controlled feedback, and statistical aggregation of a group of responses [33].

Following the sequence of the Delphi method, a panel of 13 professional experts in the fields of environmental (4) and social psychology (3), urbanism (4), urban regeneration (1), and NbS (1) was formed. In the first and second rounds, 10 experts participated. In

this study, experts are those individuals with more than 10 years of experience working on the related fields. Indeed, most of the participants have over 20 years of experience, and in some cases, even 40.

The first version of the Matrix Instrument (IM-1) consisted of 22 items referring to 11 attributes grouped around two general dimensions, which was sent to the experts together with an online questionnaire. The objective was to assess (a) the diagnostic correspondence of each attribute with each dimension (0 = no correspondence; 1 = correspondence), including the options in which the attribute could belong to both dimensions or to a different one; (b) the specific characteristics of the IM-1 with respect to its clarity in the wording of the items and its diagnostic utility or relevance through three response options (0 = no, not at all; 1 = yes, in part; 2 = yes, clearly). In the survey, the attributes were presented to avoid response bias due to the order of the attributes.

From the first evaluation phase, a new matrix instrument emerged (IM-2) that included the removal and replacement of some items and the modification or specification of others. In the second round of the Delphi method, the questionnaire related to IM-2 was sent to the experts (also online). This was structured around two sections in which the results of the first round were introduced, justifying the changes [see Supplementary Materials section for the online surveys of the two rounds of the Delphi method, as well as the Data Availability Statement section for data obtained].

#### 4. Results: NbS CoBAs Tool Validation

The Delphi method seeks to confirm the face and content validity of the NbS-CoBAs tool.

In the first round, the average inter-rater agreement in the clarity of the items was 67.8% (agreement range between 40% and 100%), with the trimmed mean, which is calculated by eliminating the highest and lowest score, being 79.4%. In 72% of the items, the inter-rater agreement was equal to or greater than 80%. Regarding relevance, the average inter-rater agreement was 71.7% (agreement range between 50% and 100%) and the trimmed mean was 82.5%. In 88.9% of the items, the inter-rater agreement was equal to or greater than 70%. Regarding the correspondence between the attributes and the dimensions, the results indicate that the considered attributes refer to the identified dimensions and not to others. However, some of these attributes are not specific to one of the dimensions but contribute to the definition of both.

As a result of the first round of the Delphi, one item (trust in the neighborhood's people, of the social cohesion attribute) was deleted as it was considered inappropriate by the experts. Due to the experts' consideration in relation to more clarity being needed, another five items were reformulated. Likewise, following the recommendation of the judges, three new items were incorporated to evaluate three new attributes. These were the facilitation of physical activity, social flow, and the ability to evoke change in an emotional state.

The second round of the Delphi was organized around two sections. In the first, the correspondence between the new attributes and the two dimensions considered was analyzed. The second section assessed the clarity and relevance of the items chosen to evaluate the three new attributes, as well as the five items whose statements or response scales had been reformulated following the comments of the panel of experts.

As a result of the application of the Delphi method, the final version of the tool was obtained. It was made up of 24 items that refer to 13 attributes of the co-benefits of NbS (see Table 1). A total of 2 of these 13 attributes are typical of the dimension that includes co-benefits in perceived general health. These two items are perceived general health and the ability to facilitate physical activity. Eight of them contribute to the social co-benefits dimension, namely the feeling of belonging, socio-environmental justice, social cohesion, participation, satisfaction with the place, perceived safety in place, social flow, and ability to generate changes in emotional state. In addition, there are three that refer to both dimensions (perceived general health and social benefits), subjective wellbeing, restorative capacity of the place, and environmental comfort of the place.

**Table 1.** Final version of structure of NbS-CoBAs tool and results of Delphi method in relation to face and content validity.

Dimension	Attribute	Question	Items	Response Scale	Validity	
					Face	Content
Perceived General Health (PGH)	Perceived General Health	How has your general health been in the last 12 months?		1 very poor; 2 poor; 3 fair; 4 good; 5 very good	100	90
	Physical Activity Facilitation Capacity	How often do you do physical exercise (walking, running . . . ) in this place?		1 never, at any time; 2 sometimes; 3 quite often; 4 most of the time; 5 always, all the time. I come here to do physical exercise	80	100
PGH+PSH	Subjective Wellbeing	Overall, over the last 12 months, how satisfied are you with your present life?		Likert scale: from 1 (not at all) to 5 (is completely satisfied with your life)	90	90
	Environmental Comfort	Please tell us, what is your degree of comfort with				
	• Visual Comfort	• what you see in this place/building, i.e., the landscape you observe?			90	90
	• Acoustic Comfort	• what you hear in this place, i.e., the sound environment?		1 not at all comfortable; 2 not very comfortable; 3 average; 4 fairly comfortable; 5 very comfortable	100	100
	• Thermal Comfort	• the thermal conditions of this place?			100	100
	• Light Comfort	• the light in this place/building?			80	90
	• Place Global Comfort	• and what is your overall comfort level in this place/building?			80	80
	Place Satisfaction	Would you tell us to what extent you are satisfied with this place (open space, building . . . )?		1 not at all satisfied; 2 not very satisfied; 3 moderately satisfied; 4 fairly satisfied; 5 very satisfied; 5 very satisfied.	80	90
Psychosocial Health (PSH)	Sense of Belonging	To what extent do you feel part of your immediate neighborhood/local area? Please think about the area within a few minutes' walk from your home.		Likert scale: from 1 (not at all) to 5 (very strongly)	90	80
	Socio-environmental Justice	In general, all people, regardless of gender, age, socio-economic status, nationality, etc. have access to the different services in this neighborhood. In general, everyone, regardless of gender, age, socio-economic status, nationality, etc. can enjoy and benefit from the green areas of this neighborhood/building . . .		1 strongly disagree; 2 disagree; 3 neither agree nor disagree/undecided; 4 agree; 5 strongly agree	80	80
					90	80



Table 1. Cont.

Dimension	Attribute	Question	Items	Response Scale	Validity	
					Face	Content
	Social Cohesion	I have enough neighbors in this neighborhood that I can ask for help when I need it.		1 strongly disagree; 2 disagree; 3 neither agree nor disagree/undecided; 4 agree; 5 strongly agree	90	70
		In general people here are willing to help their neighbors.			80	80
	Participation	Do you currently participate in any association or entity of any kind (cultural, neighborhood, sports, political . . . )?		1 no, I do not belong to any association; 2 I belong to an association, but I do not participate in its activities; 3 I participate in 1 association; 4 I participate in several associations, being very active	90	90
		Could you tell us how often you participate in the social activities organized in your neighborhood or residential area?		1 never at any time; 2 sometimes; 3 quite often; 4 I participate in most of the activities; 5 I always participate at all times	90	90
	Perceived Safety	In general, how safe or secure do you feel walking or being in this place during the day?		1 not confident at all; 2 not very confident; 3 moderately confident; 4 fairly confident; 5 very confident	90	100
		In general, how safe or secure do you feel walking or being in this place at night?		1 strongly disagree; 2 disagree; 3 neither agree nor disagree/undecided; 4 agree; 5 strongly agree	100	100
	Capacity to Generate Changes in Emotional State	What extent does being in this place cause you to change your emotional state (joy, calm, anger . . . ) in any way?		1 never, at any time; 2 sometimes; 3 quite often; 4 most of the time; 5 always, all the time	80	100
	Social Flow	When you are in this place, what extent do you feel connected with other people who are in this place?		1 never, at any time; 2 sometimes; 3 quite often; 4 most of the time; 5 always, all of the time	50	70

Table 1 shows the final structure of the NbS-CoBAs tool, as well as the results of the adequacy of its items (face validity) and its usefulness or relevance for diagnosis (content validity).

As shown, the average inter-rater agreement in the final version of the scale (IM-2) is 86.5% for face validity. The agreement range is between 50% and 100%, and in 95% of the items, the inter-rater agreement is higher than 80%. Regarding content validity, the average inter-rater agreement is 88.5% (agreement range between 70% and 100%). In 90% of the items, the inter-rater agreement is equal to or greater than 80%. The item with the lowest inter-rater agreement was that related to the social flow attribute (50% in adequacy of the item and 70% in its diagnostic utility).

## 5. Discussion of Results

### 5.1. NbS-CoBAs Tool, Disesign Process Discussion

The proposed NbS-CoBAs tool allows for the measurement of different NbS psychosocial benefits demanded by several cities during their regeneration processes. Elements such as perceived general health, subjective wellbeing, and environmental comfort (which

integrate different senses: visual, acoustic, proprioceptive, and holistic perception) are considered to successfully assess health and wellbeing benefits, besides their restorative capacity. In this regard, the aim of creating a methodology to evaluate the health and wellbeing improvement related to NbS implementation is fulfilled. This is devoted to informing different urban processes to mainstream NbS in urban planning and policy making.

The work presented in this article shows that the face and content validity of the NbS-CoBAs tool is appropriate for its application, since the average inter-rater agreement is greater than 80% (86.5% and 88.5%, respectively). Additionally, the fact that in 60% and 65% of the items on the scale, the inter-rater agreement is equal to or greater than 90%, indicates that the tool is highly reliable, as different experts are consistently interpreting the items coincidentally. This high level of agreement suggests that the tool is a suitable instrument to evaluate the co-benefits in general health, wellbeing, and psychosocial aspects of NbS implementation in urban settings or built environments. By now, research on those types of NBS psychosocial benefits was too limited [34,35], which reinforce the added value of the presented tool to offer valid instruments and methods for assessing NbS benefits on health, wellbeing, and social issues.

The item with the lowest inter-rater agreement was that related to social flow. This lack of agreement may be due to the different profiles of the panel of experts [36]. One possible explanation is that experts in social sciences may have a greater knowledge of this concept than experts in urban planning and urban regeneration.

Another notable aspect to mention is the result related to the diagnostic correspondence between the attributes and the dimensions. They indicate that there are two dimensions around which the identified attributes related to the co-benefits of NbS are grouped, (1) health and wellbeing and (2) psychosocial co-benefits, which match with those identified in the literature. However, these two main dimensions, according to the panel of experts, are not independent, as they had been theoretically defined since some of the attributes contribute to both dimensions. To elucidate this dilemma, further research is needed on psychosocial data availability to test the different possible structural models of the scale: (1) the two dimensions identified are independent; (2) the two dimensions are related or are subsumed in a more general dimension; (3) it is a bifactorial model, in which there is a global evaluation of the co-benefits to which all the attributes contribute, and a specific part that contributes to only one of the two identified dimensions.

CLEVER, together with other urban regeneration projects based on NbS, provides an optimal context to test this tool in several conditions in terms of different types of solutions, diverse urban contexts, involved stakeholders, and processes of social engagement. Together, those considered elements simultaneously provide environmental, social, and economic benefits, and contribute to build more resilient cities [37,38].

### *5.2. NbS-CoBAs Tool and Its Potential for Combination with Monitoring Strategies*

The NbS effectiveness assessment requires the combination of different metrics and methodologies to assess the multifunctional dimension of NbS. On that sense the NbS-CoBAs could play a key role to evidence the impact on the health and wellbeing [29,39]. The way this tool can be combined with other social science methodologies, such as interviews and observations, should be further explored, since this could contribute to assess the impact on other societal challenges, such as knowledge and social capacity building for sustainable urban transformation and social justice and social cohesion [40–42].

Additionally, the combination of the metrics obtained through the NbS-CoBAs tool with other indicators that can be gathered through sensors may present new assessment approaches. Thus, this can be an interesting topic to explore as more methodologies and evidence become available. The final goal is providing the more comprehensive as possible vision of the role of NbS for the challenges that cities are facing [29,43,44].

### 5.3. NbS-CoBAs Tool Replicability in Different Contexts and Fields

Despite the fact that there is a robust theoretical framework regarding the psychosocial benefits derived from NbS interventions at urban scale, there is a lack of experiences in developing standardized tools with a holistic approach to consider them [29,34]. The NbS-CoBAs tool could significantly contribute to advancing the assessment and evaluation of these types of NbS co-benefits, since it seeks to address the well-known high complexity of urban regeneration processes through qualitative people- and place-based analysis.

Since the NbS-CoBAs tool has been designed to be applied in different contexts, the tool is flexible enough to be adapted to any local context, making it a potential asset in multiple types of assessments, primarily those related to the impacts of NbS. For example, within CLEVER, a first analysis of the data gathered in Milan before interventions with different NbS [45] showcases the applicability of this tool with a previous customization of the item to the specific context, train station, built green wall, and a little garden. It thus indicates that the tool can be effectively adapted to different settings and contexts to evaluate the co-benefits of NbS implementation in urban areas.

## 6. Future Research Perspectives

The application of the NbS-CoBAs tool in different built environments in future research will be useful to improve its psychometric characteristics (construct validity, reliability, etc.), allowing for theoretical and methodological advances in the research field of holistic NbS benefits [35] in urban regeneration processes. This work is aligned with the EU commission's priority [37] of building upon more robust evidence around NbS benefits, as it derives from Task Force 2 -<https://networknature.eu/> (accessed on 31 December 2022)- as a joint effort from different European projects to define a common monitoring framework. The NbS-CoBAs tool aims to contribute to this common framework, providing a first approach to assess the impacts of NbS on psychosocial dimensions in a time-scale domain that is feasible at an urban scale to promote the replication of these types of interventions.

The flexibility of the tool together with its replication potential can provide valuable insights for policymakers and urban planners in promoting the use of NbS in urban regeneration projects, and not only to nature-based interventions [34,46–49]. The psychosocial benefits can be measured in different urban interventions, and for different social groups. An example could be the projects to improve urban accessibility for the public and for people with different abilities (physical, mental, cultural, etc.). Thus, being able to replicate the tool in other areas of intervention in the built environment is considered as a future line of research. In the same way, the improvement of the built environment does not affect the different age groups equally, so it is also important for future research to be able to analyze the co-benefits for each segment of the population according to their age, gender, origin, economic situation, educational level, etc.

We expect that, in the near future, climate change adaptation approaches supported by NbS will be implemented as a path of socio-environmental just transition, reducing harm and damage from climate change impacts, environmental degradation, and associated societal challenges [50], with special attention to vulnerable environments and communities. In addition, NbS, specifically gardening, green exercise and nature-based therapy, are effective for improving mental health outcomes in adults, including those with pre-existing mental health problems [51].

A holistic and transdisciplinary approach can be provided in favor of a truly sustainable future, such as the creation of better jobs, poverty eradication, and improved health and wellbeing [35,52].

## 7. Conclusions

The work presented proposes a novel tool, called the NbS-CoBAs tool, to assess the psychosocial benefits of nature-based solutions for sustainable built environments. The tool has been developed through a co-creation process with input from multidisciplinary

experts and has been validated by an expert panel (Delphi method). The high level of agreement of validation process suggests that the tool is an appropriate suitable instrument to evaluate the co-benefits in perceived health and wellbeing, as well as social issues of NbS implementation, which can inform urban planning and policy-making towards more sustainable and equitable urban environments.

The NbS-CoBAs tool, by enhancing existing knowledge on the benefits of NbS, also has an important contribution to the achievement of SDG 3 Good health and well-being and SDG 11 Sustainable cities and communities.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su15108046/s1>, Table S1: Final version of structure of NbS-CoBAs tool in English and Spanish. Other accessible complementary materials include: Questionnaires of the two rounds of the Delphi method for validation of NbS-CoBAs tool, available in <https://doi.org/10.5281/zenodo.7936490> (accessed on 26 March 2023).

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