IMPACT ASSESSMENT GUIDEBOOK

Developing robust monitoring and evaluation plans for nature-based solutions

Connecting Nature

Bringing Cities to Life,
Bringing Life into Cities

The Connecting Nature Impact Assessment Framework: developing robust monitoring and evaluation plans for nature-based solutions

This guidebook presents the Connecting Nature process of developing robust monitoring and evaluation plans for nature-based solutions. Robust evaluation supports planners and decision-makers in building solid evidence-based understanding as to the impact of nature-based solutions and enhancing cost-effective and socially beneficial policy, building a foundation for scaled up delivery.

The Connecting Nature impact assessment framework has been co-produced by academic partners and representatives of three European cities in Connecting Nature, which are frontrunners in the implementation of nature-based solutions. The framework aims at contributing to the development of a European standard for nature-based solutions monitoring and evaluation.

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Section 1: Common Introduction to all mini-guidebooks

[To be added by HorizonNua]

– What are NBS?
– What is the CN Framework? (Added also here, this guidebook is about the framework)

Section 2. What is the Connecting Nature Impact Assessment Framework? Developing an impact assessment framework for nature-based solutions

A robust impact assessment framework entails careful reflection and planning of monitoring and evaluation processes which pertain to the design of nature-based solutions. By definition, nature-based solutions are multifunctional. NBS assessment is central to evaluating the strengths and weaknesses of specific interventions against strategic city goals. The ultimate goal is to gather long-term solid evidence about nature-based solutions performance in particular urban contexts and for different social groups. In turn, this evidence can support smart policy decisions and adaptive co-management aspects of the NBS stewardship once installed, as well as enhance sustainability, wellbeing, and resilience in cities.

The Connecting Nature Impact Assessment Framework is a process aimed at supporting cities in developing and successfully implementing robust monitoring and evaluation plans that can deliver systematic and comparable evidence as to NBS effectiveness. This framework represents an essential tool for adapting NBS design and implementation in real time. Consequently, NBS interventions performance increases and NBS can be maintained and revitalized over time.

Evaluating effectiveness of NBS interventions is also useful in developing cost-effective policies which supports cities in advocating for pertinent investments, including exploitation of broader funding streams. Monitoring and evaluation processes advance the arguments as to the benefits that NBS can deliver. We have also learned that effective assessment will require changing current ways of planning for social resilience and regeneration that are still dominated by redundancies that derive from understanding ecological, social and economic objectives as separate and sometimes at odds with each other and reflected in the siloed thinking and structure of policy practice.

The NBS evaluation and monitoring process is developed along five steps, incorporating indicators selection and assessment. Throughout this mini-guidebook, each step is detailed with examples so that cities and stakeholders can develop their own NBS assessment plans. The five steps are represented in Figure 1.

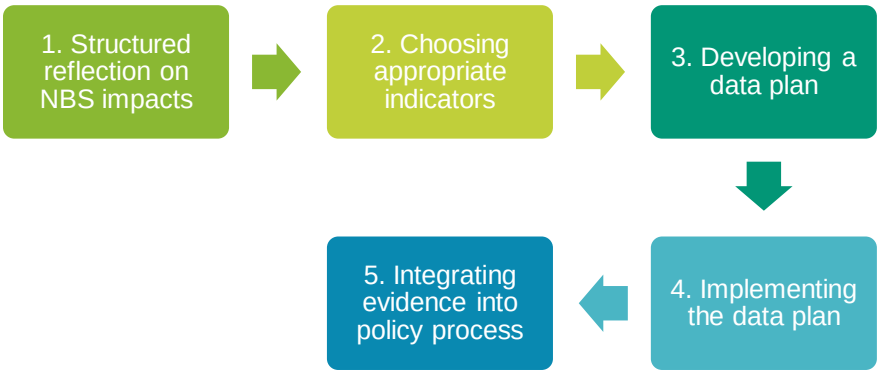

Figure 1. Steps in the NBS monitoring and evaluation process

Section 3. Steps in the NBS monitoring and evaluation process

3.1. Step 1. Engage in structured reflection on NBS impacts, pathways and trade-offs

3.1.1. Matching NBS expected impacts to the city´s strategic objectives

Engaging in structured reflection is of paramount importance in designing a functional monitoring and evaluation plan for NBS. Structured reflection supports cities in identifying context-appropriate rationales for NBS implementation and establishing evaluation objectives. Also, it contributes to the transparency and justification of policy decisions. Considering that NBS are interventions that aim to address strategic city objectives, it is important to first identify the objectives targeted by the intervention. Many times, there are some main identified objectives for the intervention (benefits), and others that are considered secondary (co-benefits).

City strategic objectives are normally defined in broad terms, while NBS will need to clarify their expected impact more specifically – geographically, demographically and over time. Nature-based solutions are expected to deliver a multi-layered impact (i.e., increased health and wellbeing for residents, increased social cohesion, new economic opportunities or environmental net gain including biodiversity). However, NBS will not necessarily deliver on all foreseen benefits. Thus, making assumptions explicit helps to identify what might be missing in NBS design. For example, if a city designs a network of urban gardens, how are these designed to support physical and mental health? Through an increase in physical activity? Through increase in social interactions? Specifying the expected benefits further facilitates appropriate planning, design, monitoring and evaluation.

The main NBS intervention impact should be clearly stated. It can be understood as primary and secondary long-term effects resulting from a chain of events, to which intervention has contributed (CGIAR IEA, 2015). These effects can happen in different spheres (i.e., health and well-being, social, economic or environmental). The chain of events constitutes the intervention pathway, a course of several actions that should be implemented to obtain expected results. The first phase of the process consists of identifying those expected results based on the city's objectives, while differentiating between outcomes and outputs.

Outcomes are results you want to achieve while outputs are actions that contribute to outcome. Outcomes are the difference made by outputs (Mills-Scofield, 2012). Using a growing space as an example, actions that are implemented to create the spaces would be outputs and outcomes would be impact that the creation of those spaces have (i.e., greater satisfaction perceived by citizens or higher levels of healthy eating). This reflection on NBS consequences and associated outcomes depends on how each city approaches its specific "theory of change". For more information on mapping local contexts and policies see Connop et al. (2019) and Hölscher et al. (2019).

3.1.2. Theory of change: identify your assumptions and map causal pathways

Approaching the city's "theory of change" requires identifying city´s assumptions as to how NBS actions and the context within which are taken will relate to expected impacts. It is necessary to build an integrated vision with regard to the NBS implementation impact on different health and wellbeing, social, economic and environmental spheres (Qui et al., 2018), and the relations among them, while contemplating the temporal, demographic and spatial aspects. The following terms are essential in determining the theory of change for a NBS intervention:

Table 1. Theory of change essential terms (based on Dumitru et al., 2020)

Terms	Description
Assumptions	Initial suppositions of how certain actions will generate the desired impact
Synergies	A positive effect in one category also has a positive effect in another impact category
Trade-offs	Achieving a positive effect in one category brings a negative effect in another or a positive effect on a social group entails a negative effect for another

Understanding the interrelation between health and well-being, social, economic and environmental spheres allows for the identification of actions that will cause synergies

with others (i.e., a greater number of green spaces could create improvements in air quality and higher levels of perceived well-being), but also trade-offs (i.e., a greater amount of green spaces can cause gentrification phenomena). Planning to prevent negative and incorporate positive trade-offs and synergies into the NBS intervention will enable cities to avoid unintended consequences. When planning, it is important to keep in mind what the objectives for the use of the data are, since planning and evaluation have multiple objectives: to assess performance vs intended benefits, to align NBS outcomes with city strategic priorities, to plan more effective NBS, to develop a data management plan, and to adapt tweak solutions over time. A good robost geographical based evidence base will help to change the policy direction of travel and could have political influence on national and regional policy as well as at local level

Collaboration between different stakeholders is essential to carry out this assessment. All components in the Quintuple Helix model should be considered (Figure 2). The objective of reaching a co-production process, understood as a deep participation that considers expert, tacit, and decision-makers knowledge, while seeking sustainable solutions that generate social resilience. Bringing together stakeholders with different knowledge is also a key driver of innovation (Frenken 2017; Handeman et al., 2015).

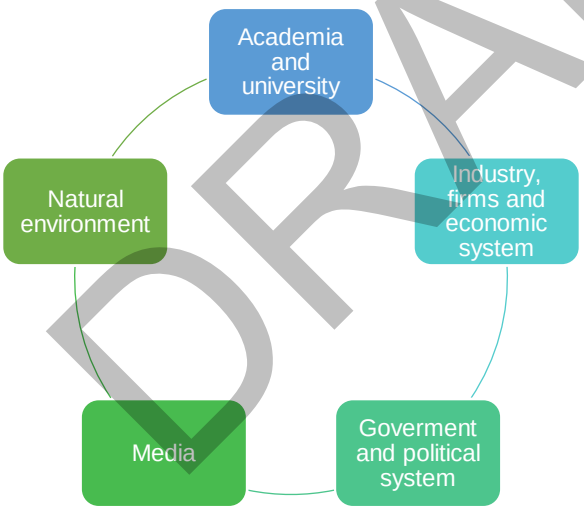

Figure 2. Quintuple Helix Stakeholders (adapted from Carayannis, Barth, & Campbell, 2012).

Each stakeholder has a particular vision of reality and how the actions carried out are interrelated. For example, the vision environmental organizations may have on how to create more green spaces to improve citizens' quality of life is not the same as the entrepreneurs' vision on how to create green businesses in the area. Therefore, all these points of view should be debated to correctly identify the assumptions and the pathways from interventions to expected outcomes. This joint debate process must include a phase of identifying possible candidate actions. Once direct and indirect effects on

expected results have been identified, stakeholders can detect possible gaps that result from the implementation process (Qiu et al., 2018).

Once the assumptions of how the NBS delivers expected results are determined, the next step is addressed to decide how to measure those impacts through indicators selection.

Within Connecting Nature Project, the mapping of the theory of change of each Front-runner city took place from joint workshops (Dumitru et al., 2019). First, a common language was established to identify city´s key strategic objectives. Then, with the help of the academic partners, the association was made between these objectives and the specific associations of the NBS. The next phase was to associate the cities´ objectives with specific indicators, through a review of literature and a co-production process where cities have made a priority ranking to differentiate between indicators that are critical to evaluating all NBS (i.e., core) and indicators that align closely with city strategic priorities but are not relevant to all NBS (i.e., feature) (Figure 3). Core indicators are recommended for all cities in order to create a holistic evidence-based framework for nature-based solutions across Europe, while feature indicators are recommended to all cities but might not be relevant to all NBS projects.

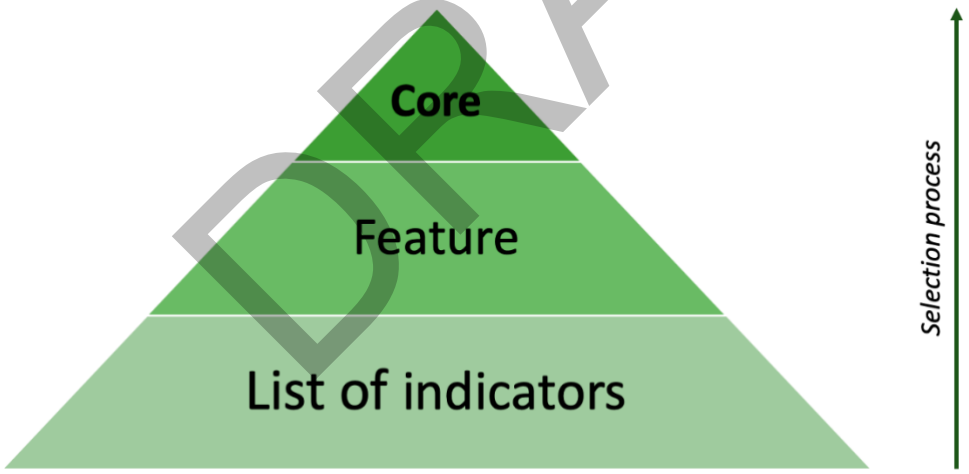

Figure 3. Indicator selection process

Once the final list of indicators was obtained, cities established the alignment of each indicator with the specific objectives, and its area of influence regarding the population. As a result of this process, the theory of change can be represented for each indicator through causal maps, where the previous actions of each one and their associated consequences can be visualized (Figure 4). These causal maps could be customized to the specific context of each city.

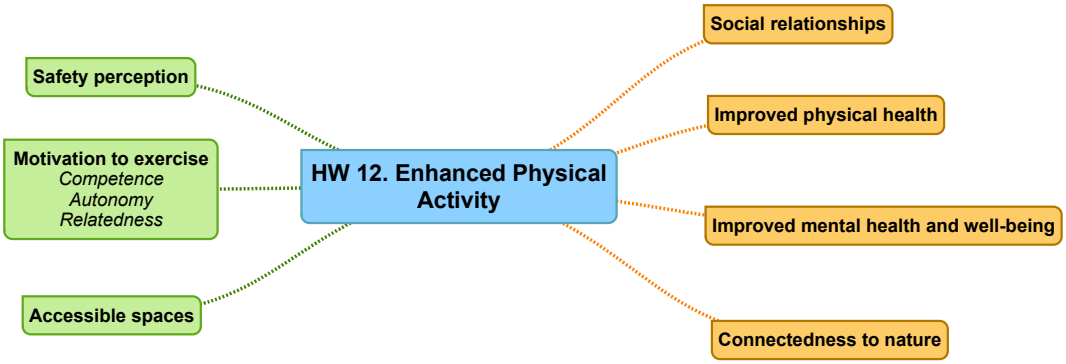

Figure 4. Indicator causal map

3.2. Step 2. Choosing appropriate indicators

3.2.1. Characteristics of good indicators

Indicators are selected to measure the expected outcomes and outputs related to project strategic objectives. Indicators should be chosen based on the previous mapping process, where the relationship between NBS actions and the expected impact (i.e., health and well-being, social, economic and environmental spheres) was determined.

Indicators selection process, conducted by local authorities, must be based on the state-of-the-art scientific evidence on NBS impacts while also engaging different stakeholders in a co-production process between cities and different stakeholders (i.e., collaboration between cities with universities can be and effective way of delivering this issue). The list of selected indicators cannot be disjointed. That is, the indicators selection process should not attempt to evaluate complex situations as if different aspects of reality could be analysed in isolated silos. Notably, synergies and trade-offs previously established must be considered. Therefore, the selected indicators must form a coherent framework where social, economic, and environmental areas of impact are inter-connected. This process allows for a broad vision of how NBS interventions make it possible to advance on the range of objectives desired by cities (i.e., improving the quality of life of citizens, but also their economic possibilities and environments).

The objective of evaluation is to compare the situation prior to the implementation of NBS with post-implementation. Therefore, selected indicators must allow periodic impact assessment. The city should be able to access the same indicators before and after the intervention (i.e., assessment continuity, data reliability, and data validity). If the chosen indicators only assess once the state of a social, economic, or environmental sphere at a given moment, longitudinal comparisons between the situation prior to NBS implementation and subsequent NBS intervention cannot be possible. As much as possible, selected indicators should fit well into official statistics or reports. For example,

if the city intends to implement NBS that improve water drainage during floods and city already monitors soil capacity, these reported measures should be included in the final list of indicators selected. Many times, indicators presented in official reports are automatically generated (i.e., the case of meteorological stations). A good review of all indicators a city is using to assess the social, economic, and environmental spheres will contribute significantly to deciding which indicators are integrated into NBS evaluation.

Sometimes, it is very difficult to apply all indicators initially selected (i.e., for reasons of economic efficiency, time constraints, personnel resources, etc.). In collaboration with stakeholders, cities must consider what is essential to evaluate in order to understand the NBS process and results. Prioritizing the most relevant indicators as well as gathering expressions of interest for testing different methods facilitates the process of establishing a final list of indicators used to evaluate NBS interventions (Dumitru et al., 2019). As previously explained, the Connecting Nature Framework distinguished between core and feature indicators.

At the European level, efforts are underway to create a common framework of indicators, based on the experience of the cities and their collaboration with the different stakeholders, mainly in universities. Accordingly, shared platforms can be created where cities can check which indicators are deemed appropriate for outcomes measurement along NBS implementation. A European Handbook of Impact Assessment is currently being elaborated and will be published soon as a cooperation of European nature-based solution projects.

3.2.2. Types of indicators

Regarding the impacts caused by the interventions in the health and well-being, social, economic and environmental spheres, the uses that citizens give to the NBS must be considered. NBS uses are measured by the primary indicators, which allow for understanding and definition of the intervention's area of influence, by knowing the communities directly involved in it, and those that may be influenced by indirect effects (i.e., new businesses arising from the movement of users to a community park).

Furthermore, it is important to assess not only NBS impact, but also the participatory aspect entailed by the way NBS were implemented, as participatory approaches to co-design, co-creation and co-management ('co-co-co') of NBS are advocated (Hölscher et al., 2019). Thus, within Connecting Nature a series of indicators were proposed to evaluate NBS interventions' development process. Table 2 provides descriptions and examples of these three types of indicators.

Table 2. Types of NBS indicators

	Description	Classification and examples
Outcome indicators	They are used to measure the expected NBS results. Based on the scientific and grey literature review, as well as through workshops with cities, the Connecting Nature project has identified four categories of outcome indicators. Each of the four categories presents an exhaustive list of indicators, which would provide sufficient information to assess the broad range of possible outcomes from NBS.	- Health and Wellbeing (i.e., General Wellbeing and Happiness) - Social Cohesion and Justice (i.e., Empowerment) - Environmental (i.e., Air Temperature Reduction) - Economic (i.e., New Businesses)
Primary indicators	The types of uses of nature-based solutions can be known, helping in the process of preparing informative maps of evaluation and monitoring. Through its users, the intervention's areas of influence can be analysed to identify the affected population. There are numerous strategies for NBS mapping, such GIS or remote devices.	- Type, frequency and duration of interaction with NBS - Perceived quality of NBS
Participatory planning and governance indicators	These indicators measure the outputs and outcomes from the NBS design and implementation process. These indicators are not intended to evaluate the final results of the interventions. However, they are considered fundamental to understand the underlying drivers of success or failure of the NBS.	- Co-production (i.e., openness or inclusivity) - Governance capacities (i.e., skills or resources) - Actionable knowledge (i.e., policy learning) - Organizational development (i.e., leadership skills)

3.2.3. Outcome indicators categories

Having presented the different types of indicators, it is time to focus on outcome indicators that facilitate an evaluation of NBS impact on health and well-being, social, economic, and environmental spheres. Based on scientific and grey literature review, and through workshops with different experts and cities, Connecting Nature selected four categories of outcome indicators: Health and Well-being, Social Cohesion and Justice, Environment, and Economic. Each of these four categories presents a

comprehensive list of indicators (core and feature) which allow for a thorough assessment of expected outcomes (i.e., baseline data, data collected during NBS implementation and data collected NBS implementation). Within Connecting Nature, each indicator has its own factsheet with detailed descriptions of methodology that will be available on the project website (https://connectingnature.eu/). More elaborated list of indicators will be also available on the European Handbook of Impact Assessment. The core indicators selected for each of the four Connecting Nature categories are presented below:

- Health and Wellbeing

Concerning Health and Wellbeing category, the following six core indicators were selected: General wellbeing and Happiness; Prevalence, Incidence, Morbidity, and Mortality of Cardiovascular Diseases (CVD); Prevalence, Incidence, Morbidity of Chronic Stress; Mental Health Wellbeing; Enhanced Physical Activity, and Levels of Aggressiveness and Violence. Examples of feature indicators are Exploratory Behaviour in Children or Chronic Loneliness.

- Social Cohesion and Justice

NBS social impact can be evaluated through ten core indicators: Bonding Social Capital; Bridging Social Capital; Trust in Community; Solidarity between Neighbours; Tolerance and Respect; Perceived Safety; Place Attachment; Empowerment; Positive Environmental Attitudes Motivated by Contact with NBS, and Environmental Identity. Feature indicators in this category were Linking Social Capital and Environmental Education.

- Environment

Within the category of Environment Indicators, 17 indicators were considered priorities with respect to NBS environmental impact evaluation: Access to Public Amenities; Air Temperature Reduction; Bluespace Area; Change in Ecosystem Service; Community Garden Area; Connectivity of Urban Blue and Green Spaces; Cultural Value of Blue-Green Spaces; Flood Peak Reduction; Green Spaces Accessibility; Green Space Configuration; Rainwater Storage; Recreational Value of Blue-Green Spaces; Reduction in Flood Risk; Soil Sealing; Species Diversity; Supporting Biodiversity Conservation, and Water Quality. Examples of feature indicators include Flood Damage and Carbon Storage.

- Economic development

For the evaluation of NBS impact in the economic sphere, 17 indicators were proposed, of which 5 were deemed to be core by the Connecting Nature project team. The Core indicators are: New Businesses 'Attracted' or Started and Additional Rates Received; Net Additional Jobs Created/Enabled by NBS; Increase in Tourism; Net Impact on Public Expenditure from NBS Implementation; and Private Finance Attracted to NBS/Bioeconomy. The 12 'Feature' indicators are: Change in GDP; Improved Business Sentiment; Innovation; Income/Disposable Income per Capita; Upskilling & Related Earning Increase; Affordable and Clean Energy; Overall Economic, Social and Health Wellbeing; Change in Natural Capital; Cost of Flood Damage; Change in Commuting Times; New customers Attracted to Businesses in the Area; Changes in Residential / Commercial Rents.

3.3. Step 3: Developing a data plan for impact evaluation

3.3.1. Baseline vs outcome data

Once the indicators are selected, the next step consists in developing a plan for impact evaluation. Implementing a good data plan is essential to correctly analyse the intervention results and establish their effectiveness. This data plan must be adjusted both to city´s theory of change and to previously selected indicators.

In order to develop a data plan, data availability must be established and clarified. Available data can come from different sources: city and external sources documents, official statistics, national or international organizations reports, peer-reviewed articles, books, and research reports. In this phase, the co-production process is again of relevance, since collaboration between stakeholders belonging to the Quintuple Helix model fosters efficient access to available data in order to evaluate the NBS.

City of Genk´s co-production workshops offers a fine example of this stage in the process. City team members held several workshops aimed at "bringing together stakeholders to identify existing data" (Dumitru et al., 2019). In this case, available data relevant to assessing NBS effectiveness was varied: prevalence or incidence of diseases statistics, physical activity reports, crimes reporting, economic indicators of local business associations, or indexes of meteorological stations in the city.

Differences between two moments in time can only be gauged if data prior to implementing NBS interventions is compared with data subsequent to NBS implementation. Thus, baseline data can be established from available data. Baseline data is information that indicates the initial (i.e., prior to NBS implementation) status of

a particular indicator. Baseline information can be obtained in two ways: 1. Accessing data available in official reports (i.e., obesity rates or nitrogen dioxide levels), or 2. Collecting data before NBS implementation. On the other hand, outcome data is represented by information obtained once NBS interventions were implemented. Unlike baseline data, it is necessary to collect outcome data during or after NBS execution. Based on outcome data, a new situation generated by NBS implementation can be compared with baseline data (Figure 4).

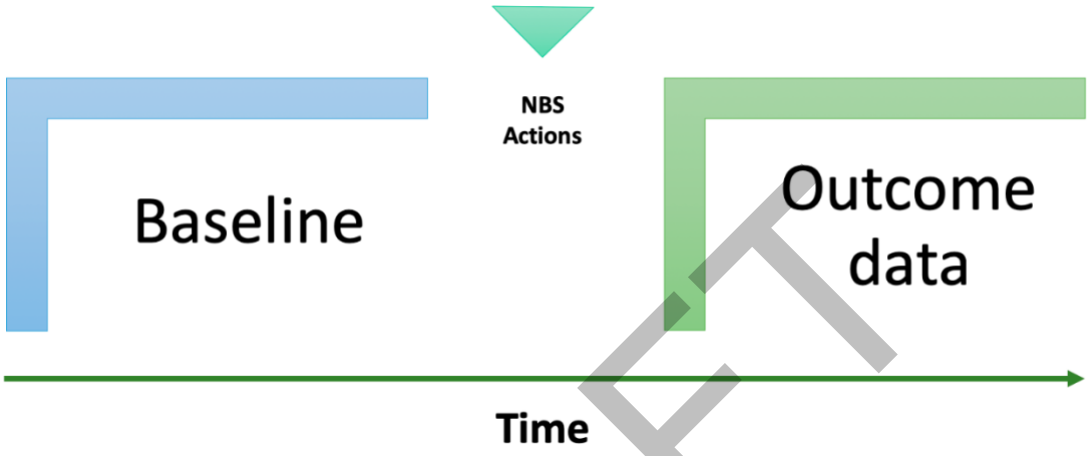

Figure 4. Baseline vs Outcome data

The NBS monitoring and evaluation process is ongoing and continuous over time. Once this stage of the framework process is complete, outcome data can become baseline information for future NBS interventions. If we do not have baseline data or a control situation (a similar context but without the NBS), there is no possibility to explore the causal relationships between the NBS actions and the NBS impact (s) assessed. In the absence of baseline data, one can only provide descriptive accounts (i.e., the environmental pollutants levels in an area) or draw momentary comparisons between sub-groups (i.e., differences in physical activity levels across different population groups). If baseline data is located or collected, NBS implementation effects can be effectively explored.

3.3.2 Things to consider in drawing valid conclusions on NBS impacts

Valid conclusions assumption is the most important criterion in establishing the presence of expected impact upon NBS implementation. That is, check that what was intended with the NBS interventions has been achieved, as impacts are determined by multiple factors. When planners and decision-makers implement a policy through an NBS, at the same time there could be multiple other phenomena that act on the expected result (i.e., creating a park in a neighbourhood to encourage physical activity

vs other community sports club programs, which are conducted at the same time, and which also seek to increase physical activity levels).

Therefore, not only it is necessary to consider direct and indirect effects between the actions, and the pathways of synergies and trade-offs previously discussed, but also to identify causality between the actions carried out in NBS implementation and different dimensions of health and well-being, social, environmental, and economic impact (i.e., the creation of a new green area has really been the cause of increased physical activity in neighbours and not another one).

Three conditions must be met to establish this causation analysis (Kenny, 1979): 1) actions included in the NBS must precede consequences (i.e., following the previous example, the community park must be created before the increase in the level of physical activity occurs); 2) as planners and policy makers modify policies, the consequences measured through the indicators should also vary (i.e., if the community park improves its facilities or increases its area available for physical activity, it will increase more); 3) variation cannot be attributed to other factors mediating the relationship between actions and impacts (i.e., creating new gyms in the neighbourhood). To document these impacts, it is important to compare the situations before and after the intervention or between similar contexts and user groups (i.e., compare the levels of physical activity in a neighbourhood where the new park was created vs. other neighbourhoods where there are no parks or gyms to exercise in).

The in-depth analysis required by this step is fundamental to data interpretation and NBS impact assessment. This step takes considerable amounts of time and commitment. Therefore, we recommend allotting proper time to navigate this phase in a way that ensures robust impact assessment. Once causal chains were considered, causality analysis facilitates valid conclusions on NBS interventions. On the whole, we recommend close contact with academic partners for indicators selection and accessing their expertise in causality analysis to monitor and evaluate NBS impact.

3.4. Step 4: Implementing the data plan

3.4.1. Characteristics of appropriate method(s)

The next phase in assessing NBS effectiveness rests in choosing the necessary methods and instruments to measure selected indicators. Here too, collaboration with academic partners and universities (or data analysts in relevant consulting/public bodies) in setting up appropriate methodologies is highly recommended. Each indicator within the four categories (Health and Wellbeing, Social Cohesion, Environmental, Economic) is to be assigned suitable data collection method(s). As shown in Table 3, relationship

between indicator and its measurement method is determined by data quality, temporal adequacy, and cost-benefit ratio assessment. Connecting Nature indicator factsheets include methodologies that follows these criteria.

Table 3. Factors to consider when choosing a method

	Description
Data quality	The data quality has to be scientifically valid, it determines the possibility of performing causality analyses. To obtain quality data, it is highly recommended to select standardized instruments (scientifically tested).
Temporal adequacy	Really exhaustive standardized instruments allow having very precise information on certain indicators (i.e., a 240-item questionnaire on levels of well-being and mental health). However, this comprehensiveness can be time consuming, which may be excessive if other instruments have to be applied to evaluate different indicators.
Cost-benefit ratio	The ideal situation is to use the best scientific methodologies, but sometimes cities have to choose based on their economic capacity and resources. However, the choice of methodology should never be unscientific.

Optimally, data collection requires attending to numerous indicators with multiple methods, instruments, and data sources. Hence, collaboration among different stakeholders is essential to developing and implementing the data plan. First, citizen collaboration is needed not only to apply the instruments, but also to obtain knowledge about NBS evolution throughout implementation phases. Citizens can become empowered in relation to their local spaces. Secondly, collaboration with partners in the industry can provide valuable information for measuring economic indicators, while media can help in data collection and disseminating the importance of evaluation. Industry can also generate data to support product development, marketing and decision-making. Finally, the universities are an indispensable partner in executing all steps along the process. If managed well, the process evolves along symbiotic dynamics where all entities benefit. On one hand, local governments obtain the necessary information to evaluate their interventions. On the other hand, the academic sector capitalizes on useful data and knowledge which can be further disseminated to advance the state of the art in social, environmental and economic research worldwide.

3.4.2. Temporality of data collection and automatization

Data collection temporality involves answering the following three questions: 1) How long should data collection take?; 2) How many times is it necessary to collect data?;

and (3) What is the expected temporal scale of the outcome?. The duration can be set based on a minimum amount of information (i.e., a fixed number of citizens representative of the general population or a sufficient number of measurements on environmental parameters). Setting a date as time limit can also be based on city specific and economic resources.

Regarding data collection frequencies, the more times selected indicators are measured throughout NBS implementation, the greater the precision of assessing the effectiveness of any expected impact. It is not necessary to wait for the end of NBS implementation to explore the changes produced and their direction (i.e., expected vs. unexpected). However, each city should estimate a timeline for expected outcomes. Using as examples two Connecting Nature NBS, an intervention that aims to increase green areas to reduce the heat island effect (City of Poznan) could verify results in a short timeframe, yet an intervention that seeks to revitalize deprived areas with green spaces for community uses (City of Glasgow) can only check the effects on social aspects through a long-term approach.

Considering these examples, and baseline data collection and causality analysis (discussed previously), a good compromise could be to collect data twice: first time, before NBS implementation (i.e., baseline) and then, after NBS interventions had been implemented (i.e., outcome data). However, it is advantageous to establish regular monitoring over time for many indicators to ensure that benefits are retained and to inform adaptive management decisions as circumstances change. Iterative data collection can allow adjustments to be made in the actions that could create a more cost-effective action

Temporality is also closely related to automatization, as data collection is repeated over time (i.e., on a trimester or yearly basis) and requires the investment of far fewer resources (i.e., personal - time, financial, etc.). It is highly beneficial to connect data collection with official national and international reporting, since good temporal overlap permits updating information relevant to NBS evaluation and monitoring.

3.5. Step 5: Integrating evidence into the policy process

3.5.1. Data analysis

NBS assessment data can be of two types: (1) quantitative: the information is collected and represented in numerical format, and facilitates the exploration of statistical relationships between different indicators (i.e., data on incidence of cardio-vascular disease) and (2) qualitative: the information is conceptual, based on descriptions, and can be organized on topics (i.e., the investigation of trust in a community during and

following NBS implementation). Depending on data type, three strategies of data analysis can be employed: quantitative, qualitative, or mixed analysis (i.e., results and conclusions of quantitative and qualitative methods are integrated for a deep understanding in assessment evaluation (for more information, consult Creswell & Creswell (2017). Cities can also consider approaches based on citizen science methods, both quantitative or qualitative.

Furthermore, within the quantitative analysis, two different ways of understanding the information provided by assessed indicators can be identified. On one hand, evaluators can present descriptive data analysis which indicates the most representative elements of the analysed data set (i.e., number of people who use a park, the average level of well-being in a community, etc.). On the other hand, we can rely on inferential analysis to explore relationships between indicators (i.e., if more green area in a city is related to lower temperatures in summer.), compare population groups (i.e., nutrition quality in an area with several NBS growing spaces compared to other non-NBS areas), or predict how some of indicators will behave in the future (i.e., if increasing the number of parks enhances the physical activity performed by members of a community). These different analyses depend on previously established.

3.5.2. Presenting data analysis results in an integrated and visual way

Unattractive data presentation (i.e., long texts without visuals does not support the achievement of effective communication between city departments and to its stakeholders (e.g., academic partners, industry, or media). For this purpose, it is highly recommended to provide visual presentations. Thus, information can be efficiently consulted, verified, and compared. Dashboards for results integration can help with possible confusion about sources of information, which dimensions are under evaluation, or what population group is assessed. Dashboards can also allow spatial and temporal integration of the information of different impacts (i.e., see the level of physical activity by neighbourhood, in different years). The Glasgow Connecting Nature Dashboard (Figure 5) offers a good example of visually unifying and integrating different results sources.

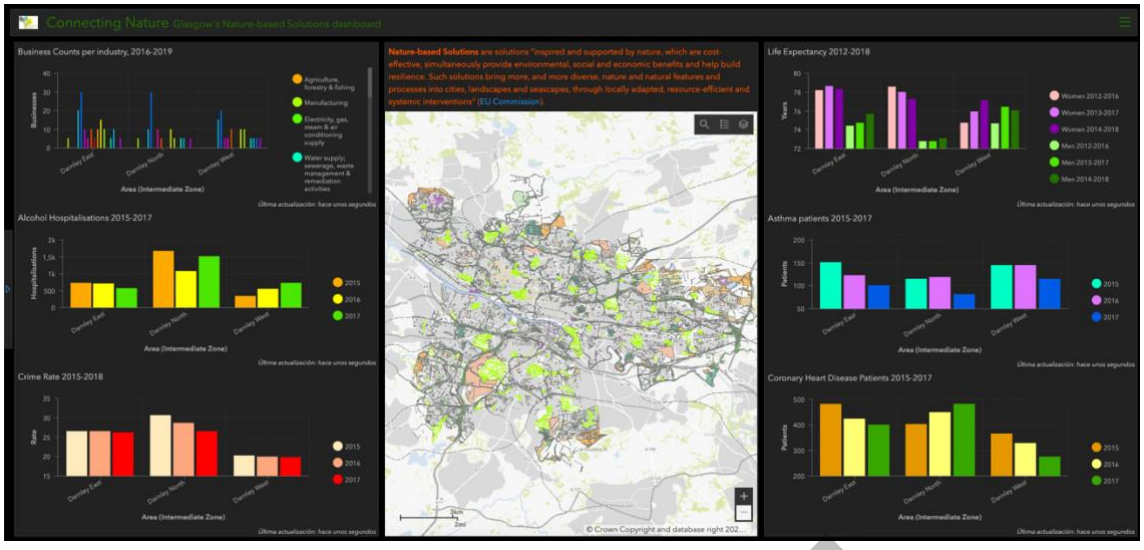

Figure 5. Glasgow Dashboard

3.5.3. Linking results with the initial theory of change and objectives

Presented results must be related to initial city objectives to see if they were adequately met. It is necessary to review the city´s theory of change and the NBS impact intended. Synergies and trade-offs between different actions should be considered when relating results to initial objectives. Next, the evidence produced is processed and fed back into the policy planning process. That is why NBS evaluation results can be used in the process of reflexing monitoring.

Reflexing monitoring is a methodology for facilitating and capturing learning-by-doing and doing-by-learning when co-producing NBS (Hölscher et al., 2019). This process is about learning in real time and *in situ*, not retrospectively. A more detailed description is available in the Connecting Nature Framework guidebook (Hölscher et al., 2020). Consequently, all the information collected during the intervention process should be used to make new decisions, re-evaluate objectives and theories of change, propose alternative explanations, and create a flow process between NBS information and desired new actions. The monitoring process will not only provide fruitful information for future projects, but involves continuous contact with data which informs NBS adjustments and empirical evidence updates.

In the overall analysis, it is necessary to be careful when modifying proposed actions due to absence of expected results. On certain occasions, expected outcomes surface along a longer time-frame than initially planned. An intervention that aims to increase de-sealing to reduce the heat island effect could verify short term impact, but an intervention that aims to enhance empowerment through community spaces can only verify the effects on social aspects on a longer time-frame.

Section 4. Transferring NBS evaluation process and results to other cities

The last phase of the monitoring and evaluation process consists in sharing the results with all those stakeholders belonging to the Quintuple Helix model (i.e., academia, industry, government, media, and natural environment), and also with the wider European and global communities. Several joint collaborative actions can help to disseminate results: scientific articles, official reports from administrations, congresses, open conferences, webinars, talks, citizen meetings, or interviews.

Plausibility of data reported is a key aspect in results dissemination, irrespective of their status as regard expected outcomes. This phase should be covered even if results do not reflect desired impact NBS objectives. It is as important to indicate that NBS contributed to desired impact(s) as it is to report when NBS interventions did not contribute to expected outcomes or even contributed to adverse consequences. By employing ethical research and data dissemination practices, NBS actions can be objectively analysed to see how NBS worked. This way, NBS implementation can be replicated and adapted by other cities within a continuous improvement framework.

Although some cities do assess the results of specific interventions, it is not common to perform the exhaustive planning of evaluation and monitoring process as the one presented in this mini guidebook. It is even less common to transfer this information to other cities. In essence, the final objective of NBS evaluation should be to create and share greater accumulated NBS knowledge. This approach is necessary to facilitate the silo-busting of departments and the unlocking of diverse funding sources that is essential to scaling up nature-based solution delivery. Therefore, creation of learning and mentoring links between cities is a guarantee for effective NBS replication within a framework of ongoing improvement and adaptation.

The Oppla platform, an NBS repository of the European Union, is an indispensable resource in sharing information on NBS implementation between cities. Oppla (2019) aims to simplify the creation, acquisition, and transfer of knowledge for a better management of the environment. This free access platform is designed for the benefit of different sectors (i.e., science, policy and practice; public, private and voluntary sectors; organizations large and small; private individuals).

The process of knowledge transfer is the essence of the Connecting Nature Project which seeks to forge the relationship between cities with great experience in NBS establishment, evaluation and monitoring (i.e., Front-runner Cities) and cities that pursue such knowledge (i.e., Fast-follower and Multiplier Cities). In order to support the scaling up of NBS across Europe, the sharing of learning and experiences is critical. European cities could become examples of well evaluated and monitored NBS

interventions, and informational hubs for acquired knowledge dissemination and transfer.

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