Horizon 2020 Programme

Clearing House

Research and Innovation Action (RIA)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 821242

Start date : 2019-09-01 Duration : 48 Months
http://clearinghouseproject.eu

Report from testing and piloting the tools in field laboratories

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Clearing House - Contract Number: 821242

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Number of pages	24
Document type	Deliverable
Work Package	WP4
Document number	D4.5
Issued by	CREAF
Date of completion	2024-03-09 17:39:00
Dissemination level	Public

Summary

D4.5 reports the main methods and findings from WP4, Task 4.4. Piloting in UF-NBS field laboratories. It includes the process description of piloting in real-world situations in selected case studies and the steps of the roadmap. The tools developed in CLEARING HOUSE facilitate the integration of the various bodies of information, e.g., scientific knowledge and perceptions of urban forests as nature-based solutions (UF-NBS), allows learning, operationalising and implementing the UF-NBS. MyDynamicForest is a citizen science tool, designed to identify the perceived UF-NBS traits and addresses different challenges for each case study city (i.e. air pollution and green management in Barcelona; the impact of drought on tree health in Leipzig; or the uses, barriers and appreciation of blue-green areas in Krakow). SIAC (Spatial Impact Assessment and Classification) is written as a plugin for the QGIS open-source desktop GIS; SIAC and assesses conditions of urban forests as nature-based solutions and estimates the benefits provided by UF-NBS at a local level. SIAC supports addressing the assessment of tree cover, tree species richness and diversity, modelling/assessment of tree cover connectivity, carbon sequestration, or pollutants removal. The SIK-Hub (Spatial Information and Knowledge Hub) allows a quick assessment of UF-NBS and their environmental, ecological, and social settings based on the visualisation, synthesise, and story-telling of spatial data and information. Both SIAC and SIK-Hub are closely linked with IUCN Global Standard for Nature-based Solutions, as well as the IUCN Urban Nature Indexes. City of trees is an educational package about the benefits of trees and forests in the city, for children between 10-14 years. The educational material is structured around the introduction of trees and forests as facilitating learning, but also covers other aspects related to UF-NBS in cities and its challenges to reinforce the concept of connection with nature. All the tools were tested and the improvement suggestions were incorporated. Local ground-truthing in selected case studies and communications campaigns were part of the piloting. The educational package was translated into various languages to support engaging. In Barcelona and the surroundings, the educational material has been downloaded by more than 100 schools. Both decision support and citizens science tools have been launched in selected case studies and can be used across various ecosystem typo...

Approval

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EXECUTIVE SUMMARY

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KEYWORDS

Nature-based solutions; Tree benefits; Piloting; Perceived traits; Decision support tools; Citizen science; GIS; Knowledge hub; Education

RECOMMENDED CITATION

Basnou, C., Scheuer, S., Wolff, M., Haase, D., Sheikholeslami, D., Vidal, E., Bergier, T., Czaplarska, A., Aulotte, E., Kilpi, K., Pino, J., De Vreese, R. (2024). Report from testing and piloting the tools in the field laboratories (D4.5.). H2020 project CLEARING HOUSE, grant agreement no. 821242. DOI: 10.5281/zenodo.10721189

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1. INTRODUCTION

1.1 Background

To support the implementation and management of urban forests as nature-based solutions (UF-NBS hereafter), the CLEARING HOUSE project is committed to the development of decision-support tools. The main aims of tool design and testing were to reinforce entire (cycle) process of planning, designing, deploying, governing, managing, and monitoring UF-NBS, including feedback, (re-)planning, re-designing and adaptive management.

The tools respond to key themes in CLEARING HOUSE:

- Multifunctionalities of UF-NBS, assessment of biodiversity, ecosystem services and functions;
- UF-NBS for global/climate change adaptation;
- UF-NBS for promotion of health and well-being;
- Citizen awareness and engagement towards UF-NBS benefits;
- Identifyes problems/barriers and opportunities;
- Understanding citizens perceptions;
- Align data to key IUCN and EC products;
- Support governance;
- Produce and visualise key indicators of socio-ecological challenges of UF-NBS traits;
- Support the easy and interactive exploitation and dissemination of CH results;
- Responding to cities needs.

This deliverable (D4.5) – Report from testing and piloting the tools in field laboratories – is part of WP4. The main goal of WP4 is to synthesise the findings of the research, knowledge exchange and learning work in CLEARING HOUSE into a set of functional tools for key end-users in Europe, China and worldwide. The WP4 Kick-off Workshop held 30 April 2022 was considered as the actual WP4 start, during which the framework of further work on all four WP4 tasks were discussed, refined and planned.

D4.5 reports the main methods and findings from Task 4.4. Piloting in UF-NBS field laboratories. It includes the process description of piloting and the steps of the roadmap. The initial goal of T4.4 was to test and pilot the tools (especially those developed in Task 4.2. Developing decision support for UF-NBS implementation, but also in other WPs) in real-world situations in selected case studies (i.e. test the tool for real UF-NBS delivery). According to the changes in the second grant amendment (October 2022), T 4.4. broaded the scope and included other CLEARING HOUSE outcomes (such as the citizen science tool developed by HUB within Tasks 3.3. Developing and implementing a citizen science monitoring of UF-NBS impact or the educational package “City of trees” developed by BOS+ in WP5), adaptating the methodology to the workplan of other tasks or context. Task 4.4 also supported the external launching of tools, together with T4.2 and WP5.

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1.2 Overview of the tools developed in CLEARING HOUSE

CLEARING HOUSE has been designing, developing and implementing various tools, e.g., in WP3 (Task 3.3) and across WP4, to address the research and innovation landscape around the concept of UF-NBS in various urban field laboratories. One of the characteristics of the UF-NBS is that they also encompass societal perceptions and resulting demands for ecosystem services. To support this, the tools proposed by CLEARING HOUSE facilitate the integration of the various bodies of information, e.g., scientific knowledge and perceptions of UF-NBS, as outlined in Figure 1.

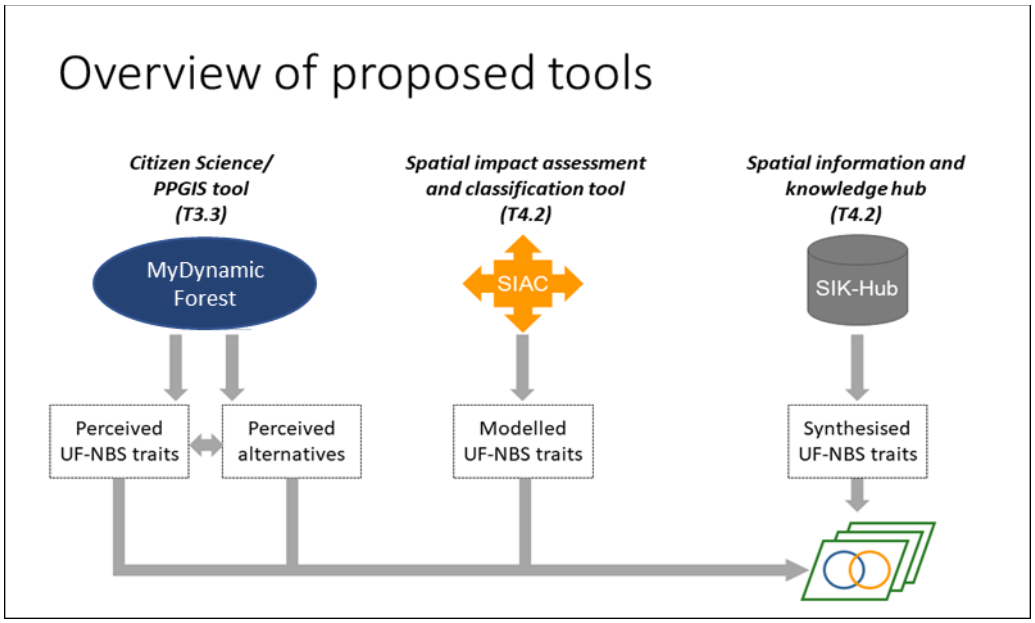

Figure 1. Conceptual scheme of the tools developed by HUB in the framework of CLEARING HOUSE: MyDynamicForest, SIAC and SIK-Hub (Wolff et al., 2021)

MyDynamicForest is a citizen science tool (Task 3.3), designed to identify perceived UF-NBS traits around the following broad themes:

- Understanding baseline UF-NBS conditions in terms of citizen appreciation and perception, including accessibility to UF-NBS, dangers and threats/ecosystem disservices, barriers, conflicts;
- Multifunctionalities of UF-NBS, including UF-NBS for recreation, social balance, green compensation, accommodation of overlapping functions;
- Cultural ecosystem service delivery;
- Assessment of tree health;
- Ecological connectivity and biodiversity;
- UF-NBS for climate change adaptation, including adaptation to heat waves;
- UF-NBS for promotion of health and well-being, including noise abatement;

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- Citizen awareness towards UF-NBS benefits.

The tools allows location-based approaching of citizens/stakeholders – a specific urban park, a neighbourhood, or city-level – and it uses narrowed-down, short surveys that are repeatedly filled in by citizens at differing locations. It was designed to offer various surveys that address different interests and challenges, as explored for each case study city.

The **SIAC (Spatial Impact Assessment and Classification)** tool is a prototypical implementation of the UF-NBS typology developed in CLEARING HOUSE (Scheuer et al., 2023).

As such, SIAC seeks to implement a data-driven identification of UF-NBS qualities (traits), e.g., with respect to spatial-morphological or topological characteristics. SIAC is conceptualized as toolbox that supports a first approximation of UF-NBS conditions and/or benefits at local level, based on selected indicators. Indicators speaking towards local conditions refer to themes of, e.g., biodiversity and connectivity, whereas indicators on UF-NBS benefits include, e.g., local cooling potential (Scheuer & Haase, 2023).

The **SIK-Hub tool (Spatial Impact Assessment Tool)** is an interactive web-based application that synthesizes CLEARING HOUSE findingsSIK-Hub produces and visualizes thematic key indicators of socio-ecological challenges and UF-NBS traits along three spatial scales, i.e., continental scale, city scale, and local scale. As a function of scale, and thematically aligned to key IUCN products such as the Global Standard for Nature-based Solutions and the as well as the IUCN Urban Nature Indexes, SIK-Hub is intended to deliver indicator-based evidence for e.g. policy analysts and decision-makers, but also for local residents or interest groups with complimentary degrees of detail. Interactive summaries, maps, and storylines shall make knowledge and findings accessible and comprehensible.

The **educational package "City of trees"** contains an attractive set of 15 lessons about the benefits of trees and forests in the city, for children between 10-14 years. It was designed by BOS+ in WP5. The material contains two main parts: an inspirational package for education and one for students. The educational material is structured around the introduction of trees and forests as schoolsubjects, but also coveres other aspects related to UF-NBS in cities and it schallenges (i.e. regreening the cities, importance of green schoolyards, challenging behaviour, observing nature, healthy cities, teaching outdoor etc). The lessons also reinforce the concept of connection with nature. The weakened link to nature that pre-teens experience also means a weakened position for the urban greenery as the youth will not grow up understanding their inherent value and therefore will not be there as citizens demanding more livable cities and protecting the existing natural environments in the cities. In order for the average citizen to understand the importance of the urban forests, some basic knowledge has to be introduced into education to facilitate the raising of citizens who understand, value and want to safeguard healthy urban forest ecosystems in the future.

1.3 Concept development

Two products from the International Union for Conservation of Nature (IUCN) informed the conceptualization and design of these tools. The tools facilitate data collection and processing, aiding users in assessing how nature is integrated into cities, as well as supporting the holistic and sustainable design, implementation, and maintenance of Urban Forests as Nature-based Solutions interventions.

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Urban Nature Indexes

IUCN's Urban Nature Indexes (UNI) are designed to help cities track their ecological performance. They offer science-based targets for improvement and monitor progress. The UNI consists of 30 indicator topics across six themes. It is a flexible tool that lets cities assess their needs, capabilities, and resources via a Capacity Assessment Questionnaire. This tool aids in choosing the indicator topics that best tackle local challenges. The indexes aim to enhance environmental transparency and accountability, support goal-setting, and spur on conservation efforts.

The information generated by SIAC and SIK-Hub will support municipalities in assessing the habitat and species status of the urban forests within their jurisdiction holistically, as well as nature's contribution to people (themes 3, 4 and 5 of UNI). By modelling and assessing tree covers and their connectivity, the tools support the assessment of land use (3.1), vegetation cover (3.4) and connectivity (3.4) of theme 3 (habitat status of UNI). The tools also contribute to the assessment of theme 4 (species status), by the modelling and assessment of tree species richness and diversity. Furthermore, the SIAC tool also contributes to UNI's theme 5 (nature's contribution to people) by assessing the impact on human health (UNI's indicator 5.3).

IUCN Global Standard for Nature-based Solutions

The IUCN Global Standard for Nature-based Solutions offers clear parameters for defining Nature-based Solutions. It provides a common framework to aid in designing, implementing and monitoring NBS actions, such as urban forestry, in cities and urban environments.

This resource assists municipalities, landscape architects, city planners and other stakeholders in designing and implementing effective interventions. It also aids in assessing the impact towards achieving sustainable cities. The Global Standard comprises eight criteria (Figure 2) and addresses the pillars of sustainable development (economy, environment, and society) comprehensively, ensuring the intervention's sustainability and impact.

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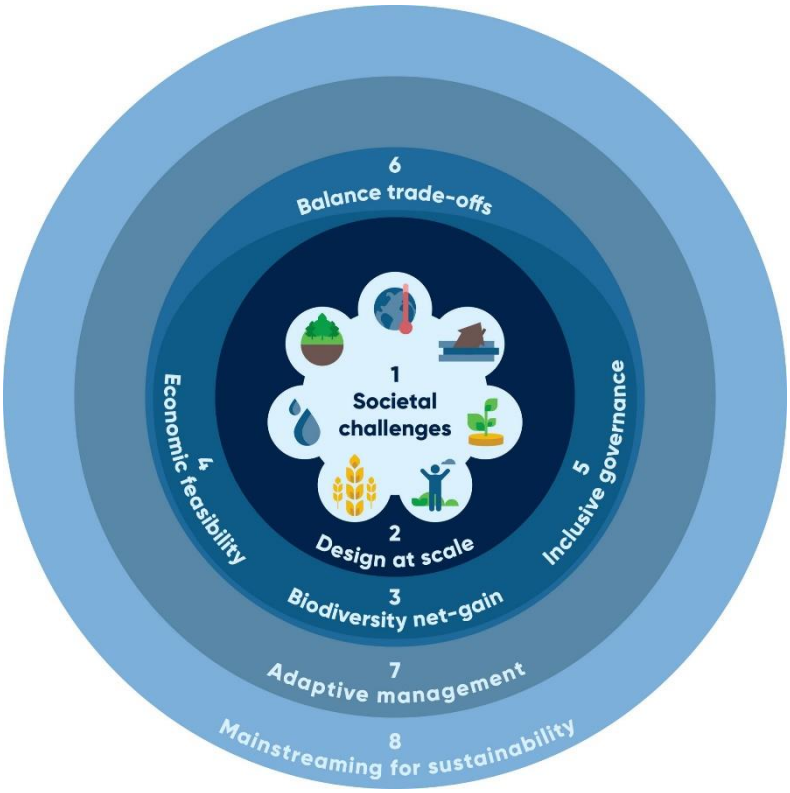

Figure 2. IUCN Global Standard for Nature-based Solutions (IUCN, 2020)

For interventions to be considered Nature-Based Solutions, they must deliver benefits for nature through enhancing ecosystem integrity and strengthening biodiversity. Assessing the biodiversity outcome of NBS interventions requires data collection for baseline assessment and monitoring. This aspect is the focus of Criterion 3 of the IUCN NBS Standard (NBS result in net benefits to biodiversity and ecosystem integrity). Criterion 3 guides the users to collect information regarding assessing the current state of the ecosystem within the intervention site at an appropriate spatial and temporal scale, identifying and integrating opportunities for enhancing ecosystem integrity and connectivity, periodic monitoring of the state of the ecosystem and identifying and measuring biodiversity outcomes. The SIAC and SIK-Hub support the data collection and synthesis regarding this Criterion.

The tools also contribute to Criterion 1 of the IUCN NBS Standard (NBS effectively address one or more societal challenges) by providing data for benchmarking and assessing multiple outcomes of the NBS intervention such as improved air quality (Indicator 1.3: Human wellbeing outcomes arising from the NBS are identified, benchmarked and periodically assessed).

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2. METHODOLOGY

2.1. Roadmap and criteria for piloting the tools in UF-NBS field laboratories

Piloting guided testing the protocol, with adapted and flexible methodology for each set of tools. The main ideas of piloting in CLEARING HOUSE are summarised in Box 1. It also assured the creation of a small group of adapted teams (i.e. in terms of skills) to set up the testing environment. For instance, a large array of skills were needed at different stages and for different tools (GIS expertise for SIAC, experience and knowledge of ecosystem services demands and citizen science projects for designing the surveys or good communicatin or teaching abilities for piloting the educational package).

Box 1. Piloting:

- Tells you if the tools will work
- Confirms feasibility and scalability
- Enables small-scale testing (real-word situations) before the final launch
- Facilitates users evaluation
- Enhances the relationships with urban forests

The testing protocol was based on desiging the main rules (steps) and ensuring that the tools respond to their objectives, including users' needs, resources and skills. It also defined cities and small groups of users for piloting, established the timeline for feedback and assisted tools launching and dissemination. At all stages and for all tools, the main criteria targeted were **usefulness and impact**, and both cities and researchers were asked to assess whether the tools will be able to generate data which tell a meaningful story for them. Based on teams' feedback, the tools developers could further refine the applications (tools), to enhance its features and ensure it meets user requirements before launching. Testing and piloting also helped to identify potential errors before the tool's launch (i.e. in case of SIAC and SIK-Hub).

Task 4.4 was a key facilitator to achieve the integratious of various tools, as it conceptualized and implemented the piloting of CLEARING HOUSE tools and their testing in case study cities (Table 1). As such, T4.4 assisted in the implementation of citizen science tool (T3.3), and of the decision-support tools (T4.2) across WP4.

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Table 1. Summary of tools piloting strategy

Tool	Typology	Testing and piloting	Main characteristics	Cities (real world situations)	Methodology	Feedback
My Dynamic Forest	Mobile	Pilot testing	Perceptions Green space management Ecosystem services demands	Barcelona, Gelsenkirchen, Leipzig, Krakow	Itineraries in the cities	Before the public release (testing) After the public release (Quote testimonials)
SIAC	GIS plug-in	Pilot testing	Spatial analysis Mapping	General	Mock-up (test) session of CLEARING HOUSE tools Testing team in Barcelona	Before the public release (testing) After the public release (Quote testimonials)
SIK-Hub	Web	Pilot testing	Indicators Decision making	Barcelona, Brussels, Gelsenkirchen, Leipzig, Krakow	Mock-up (test) session of CLEARING HOUSE tools Testing team in Barcelona	Before the public release (testing) After the public release (Quote testimonials)
City of trees	Educational material	Beta testing (after the release of the product)	Education Building empathy towards nature Raising awareness on benefits provided by urban trees and forests	Barcelona, Brussels	Webinar Project web feed-back (Green4children local web enabled for Spanish schools) Local workshop (cancelled dur to pandemic)	Aimed at offering user feedback to product developers Quote testimonials (Barcelona schools)

The cities were accompanied along this process and the roadmap (Figure 3) was explained in various meetings with the cites (i.e. during the mock-up presentation in February 2023 or city of Krakow meetings with stakeholders in autumn 2023). The mock-up event (workshop including mock-up

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presentation of SIAC and SIK-Hub) took place on 21 February 2023, leading to milestones MS28 ("Mock-up template of the application evaluated by users") and MS29 ("Mock-up template of the benchmarking tool evaluated by users") to be achieved.

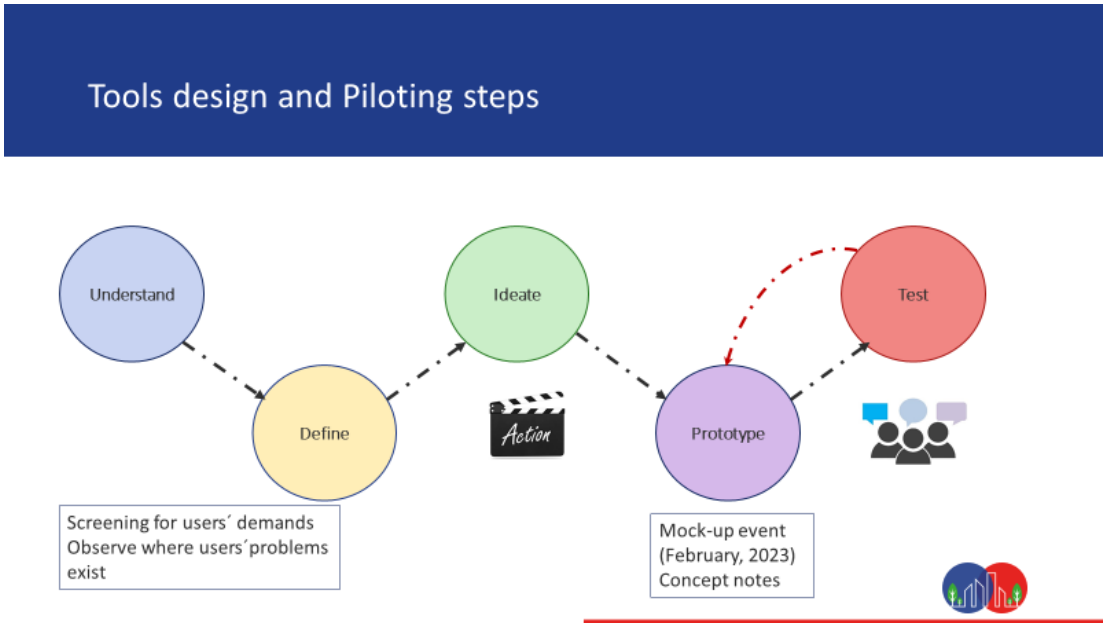

Figure 3. General roadmap for piloting

Criteria for testing and piloting the decision support tools was based on the following guidelines:

- Documentation/User Manual
  - Does it provide enough guidance and information?
  - Is it understandable?
  - Sufficient documentation of inputs and particularly of outputs?
  - Sufficient documentation of indicators?
  - Where would more details be needed?
- Tool functionality
  - Is the installation too difficult?
  - Impressions on the state of the current feature set
  - Impressions on the user interface (i.e. clarity of lables and explanation, user navigation and operating of functions, visualization)
  - Are there issues related to workflow, use of tool functions?
  - Technical problems, errors, crashes
- Data quality and usability
  - Is it easy to trace data or to integrate with other data? (i.e. import/export data, easy to understand and interpret data/do data tell a meaningful story, analyse the data, clear outputs)
  - Is it usefull for planning and research? (See: test indicators, feasability, meaningful, realistic, easy to communicate, do you imagine the tool easily adopted by agencies in your city …) also

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for e.g. data-scare comunities, which indices are useful/missing, what gap are they filling, do they support your decision making

- Outputs
- Usefulness, relevance of indicators, generated data?

2.2. Piloting steps

2.2.1. MyDynamicForest (citizen science tool)

In line with M3.9 and the testing protocol, the proposed process for the citizen science tool includes the following main steps (stages), conducted at case level: (i) establishment of a point of contact; (ii) definition of research interest, i.e., identification of key challenges or pressures to be investigated (e.g., drought stress, air pollution, etc.); (iii) survey design, i.e., the conceptualization of a brief and focused questionnaire, considering also re-use of available knowledge or previously conducted surveys etc.; (iv) definition of a geographical feature of interest, i.e., the research area of interest for which the survey will be made available; (v) localization, i.e., translation of the tool and survey into locally relevant languages; (vi) local testing, and (vii) kick-off of the public data collection.

The evaluation of local testing, i.e., comments to be collected, discussed after finalization of action) is guided by several open-ended questions, for example:

- Do you think this CS app is useful?
- Does it respond to your needs?
- Does it cover the major challenges in your area?
- Does it call for action?
- What would you improve?
- Other issues you would like to comment?

Based on the shared feedback, e.g., the level of complexity of the surveys can be adapted/ decreased if deemed necessary, items be rephrased, wording optimized for brevity etc.

The described process was a “rolling process”, with case studies testing and piloting in different stages along 2022 and 2023. Figure 4 summarises the piloting roadmap for the citizen science tool, explained to the cities in autumn, 2022. At that stage, Barcelona and Leipzig piloting were finished and presented as an example of case studies.

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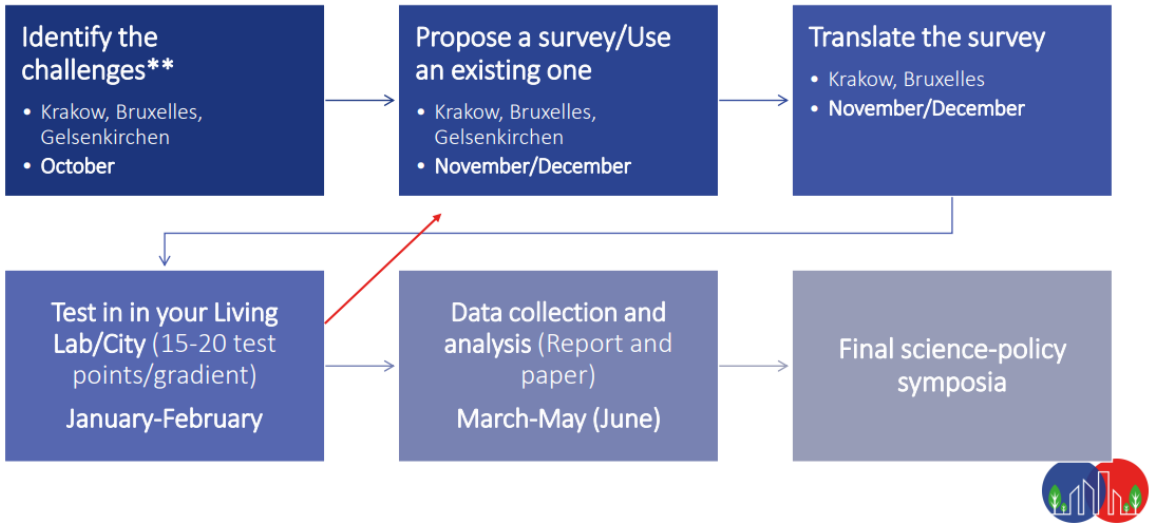

Figure 4. Piloting instructions and timeframe of citizen science tool, at different stages of the process

Local testing of app and survey is a key pre-requisite to kick-off public data collection. It includes functional testing (i.e. installation, error messages, language, other app functions etc) and the use of the survey in the field, to evaluate its usefulness against the case-specific research interest and rationale, and to identify problematic issues in survey design that require attention, including wording, or missing response options deemed necessary etc. Local testing may be conducted at selected sites of interest, or along a pressure gradient, e.g., within areas that resemble existing, new or restored UF-NBS. T4.4 recommended sharing feedback based on a collection of at least 20 ground points within such sites, or along such transects, to properly evaluate app and survey under various conditions.

Testing was conducted by CREAF in ***Barcelona***, using the app at selected locations, as part of an iterative process. I.e., suitability of the app and survey were repeatedly tested, along a transect collecting recommend ground points, and issues in regard to app or survey design that were identified, including, e.g., items/options for answers missing, change of wording to items, etc., being addressed for a subsequent re-evaluation by CREAF.

MyDynamicForest needs location-based information to provide real information about the user's surroundings (geolocation). Therefore, the tool was also properly tested in the field. For ground truthing, two testing areas were chosen, corresponding to different ecosystems and urban pressures: the city of Barcelona and Collserola peri-urban forest. Ground testing was realized by two independent persons, along a random itinerary, each of about 20-25 points.

Once the tool was ready for launching, some cities accompanied the piloting process of the citizen science tool with various communications actions (Figure 5 summarises some of these actions in Barcelona).

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Figure 5. Examples of blog posts and media releases to raise awareness and encourage the use of MyDynamicForest app (in Spanish and Catalan; source: CREAF)

For ***Leipzig***, the conceptualized survey was tested by a larger group of Bachelor and Master students, as part of two excursions/field trips. The students were asked to map perceived tree damage traits for park trees at selected UF-NBS locations (i.e., within selected urban green areas), using the app and the implemented survey, resulting in several thousand ground points. In so doing, the suitability of the survey as well as proper functioning of the app could be evaluated for this case.

The focus of the ***Gelsenkirchen*** case was on the identification of green space uses, the elicitation of user expectations/user demands, and of potential barriers/conflicts. Therefore, the survey is overall in line with the CLEARING HOUSE citizen science theme to understand baseline UF-NBS conditions and perceptions. Moreover, in this case, anchor points to previous research conducted locally were identified and subsequently considered in the survey conceptualization. More specifically, this especially refers to a previously identified local sense of place, i.e., with citizens tending to revisit specific urban green spaces/UF-NBS for long periods of time. By determining perceived trends of place-based local change, i.e., potential improvements of local conditions, e.g., due to management, or diminishing appreciation due to an increase of conflicts/barriers, CLEARING HOUSE considers such previous findings.

Understanding citizen's awareness towards UF-NBS and their perceptions of selected UF-NBS traits has also been the main theme for the ***Krakow*** case study. Here, a spatial focus was on the Drwinka river park, and CLEARING HOUSE activites supported the elicitation of green space user perceptions, including a valuation of beneficial traits supporting use intentions, as well as of potential conflichts and barriers. In line with the local city parner's interests, citizen support for local action, particularly of establishing formal protection for the research area, were additionally identified.

For the ***Brussels*** case study, piloting of the tool was planned to take place as part of the 30-30 campaign by CLEARING HOUSE partner BOS+ and the Health Insurance Association CM. The campaign

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has however only been confirmed at a very late moment, too late to include the testing of the citizen science tool within Belgium.

2.2.2. SIAC and SIK-Hub (decision support tools)

For the development of the decision support, the first steps of piloting (Figure 6) were designed by HUB during the WP4 kick-off meeting. The meeting was organized as a co-design process, where all the participants have their inputs, to understand the demands (Wolff et al., 2021). The screening was organized in 4 main blocks and the answers were gathered throught Miro system.

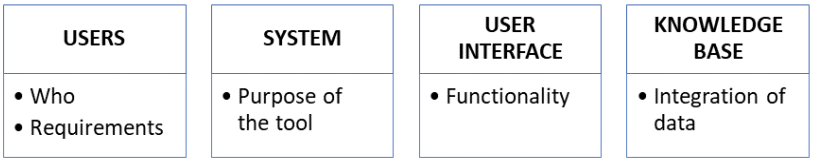

Figure 6. Screening for users demands, as a first step in the piloting process of SIAC and SIK-Hub, during a co-design meeting

2.2.3. City of trees (educational package)

The design and launch of the educational package was preceded by a *survey*, to understand educational needs of schools. The survey was also translated in Catalan and sent, embedded in a blog post, to the schools in the region of Catalonia (Spain).

Together with BOS+, CREAF has been involved in disseminating and piloting the educational package at regional scale, designing a roadmap for piloting, that included an important communication strategy that accompanied the process from the very beginning (Figure 7). Storytelling promoted attractive key messages (*why not hold more classes outdoors?*; *regreening childhood* or *rethinking learning environments*) to raise awareness and to engage the educational community with "City of trees".

Piloting process was built as an opportunity for trees and urban regeneration and promoted the following key messages:

- Reconnection with nature,
- Enhancing outdoor learning and implementation of NBS for schools (i.e. green schoolyards),
- Enforcing synergies with initiatives in transversal areas (science-policy interface).

The educational package was translated into 7 languages for now (more translations of the lessons will come) and can be downloaded from CLEARING HOUSE web.

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Figure 7. Piloting steps for "City of trees" (educational package), exemple of the process of local testing, at regional scale (Catalonia, Spain)

3. RESULTS: testing and piloting the tools

This section provides the description of piloting solutions for every tool. The developing team (HUB) incorporated all the minor suggestions of the testing team and improved the tools. The tools were presented and launched during the final event, *Re-greening cities with Nature Based Solutions in Europe and China – bridging science, policy and practice* (Brussels, November, 2023).

3.1. MyDynamicForest

For each case, in the context of the aforementioned themes, a survey has been designed in line with core interests of the case study partner (T3.3), and subsequently tested and kicked-off as joint activity (T3.3, T4.4). This process is guided by the CLEARING HOUSE citizen science methodological framework (M3.9) and a testing protocol developed by CREAF together with HUB. The testing protocol reflects on the tool's objectives. It thus (i) seeks to enable user (case)-oriented outputs and impacts in a flexible manner; (ii) emphasizes that activities are tailored to city needs, hence, filling knowledge gaps at this level in line with partners' research interests; and (iii) seeks to support further UF-NBS implementation and/or encourage action.

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For **Barcelona**, the app is conceptualized to map perceived air pollution/air quality, with the rationale exemplified in Box 2 guiding survey design and testing. An example of functional testing is presented in Figure 8.

Box 2: Rationale for citizen science for the Barcelona case.

- Identification of perceived traits with respect to air pollution
- Elicitation of health/well-being impacts, including a personal evaluation of each impact. Thereby, site-specific severity of impacts can be assessed, as likely indicator of level of pollution/air quality.
- Elicitation of avoidance strategies, including intentions (avoidance of certain activities), and spatial (avoidance of certain locations), and temporal (avoidance of certain times) aspects, and a personal evaluation of each strategy with respect to their perceived effectiveness in helping to avoid air pollution.
- Broad elicitation of perceived amount (and potentially bad quality) of local greenery, and accessibility to urban green spaces.
- Elicitation of perceived pathways to improve air quality locally.
- Impacts of trees/green spaces indirectly considered as follows: (i) perceived amount of greenery may be related to perceived severity of health impacts/pollution; (ii) visiting green spaces as avoidance strategy may speak to tree benefits regarding air quality (demand), with perceived accessibility as indicator for supply; and (iii) green pathways.

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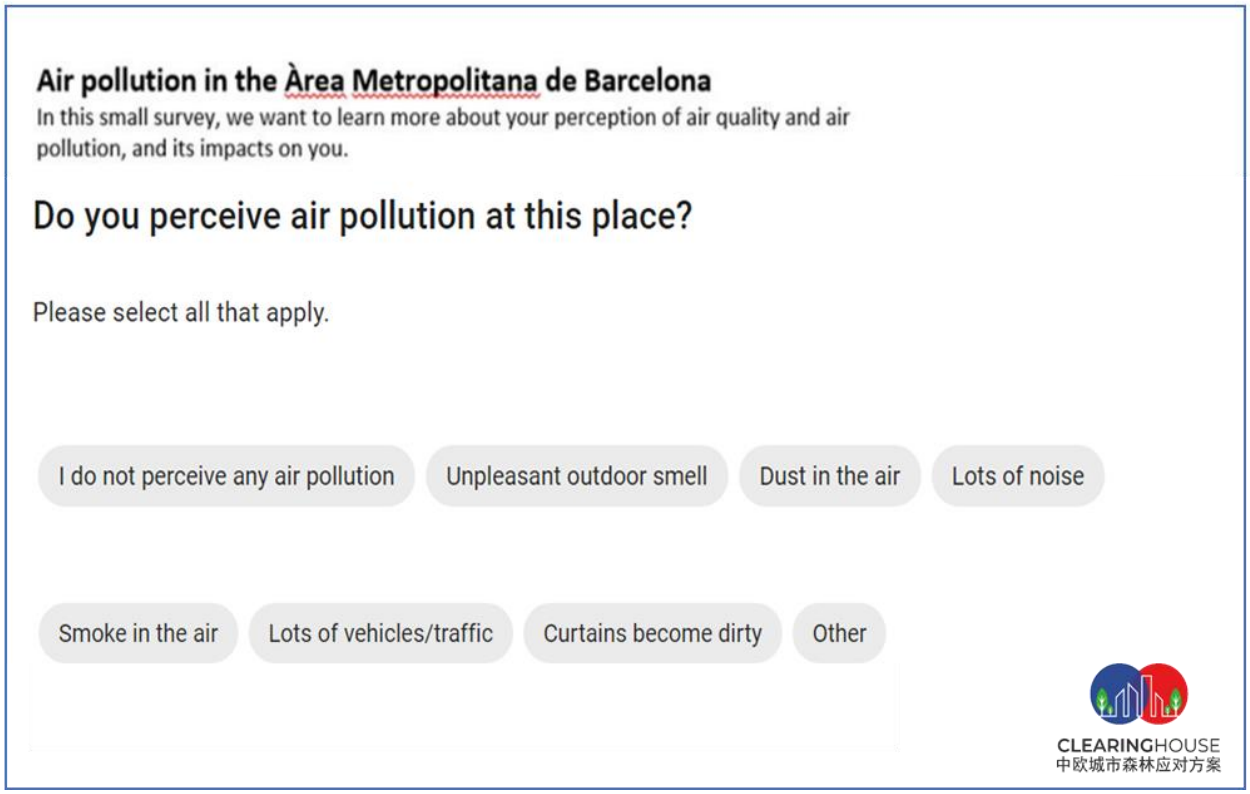

Figure 8. Snapshot of an example of citizen science survey for Barcelona, after the trial and error process

3.2. SIAC

Testing SIAC – feed-back summary (September, 2023)

Following a first series of internal tests regarding deployment, functionality, and overall software stability involving CLEARING HOUSE partners HUB and CFRI, a more in-depth testing and evaluation was conducted by a small team from CREAF. Experts in GIS and green urban planning tested the SIAC plug-in (WP4) during a couple of weeks (July, 2023), simultaneously evaluating the tool's documentation, based on previously elaborated testing guidelines, questions, and criteria. The following feedback has been shared with the tool developers:

- According to the version tested in July 2023, the installation was successful. It should be noted that the installation requires knowledge of a GIS expert. However, there were not crashes or technical problems when installing the tool.
- Overall documentation accompanying the plug-in GIS is complex and very well structured. Where needed, suggestions for improvements were made for certain sections and documented for HUB team. The tool provides relevant outputs for decision-making processes, with a large array of parameters and indicators.

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- Despite deployment of the tool potentially requiring more-advanced GIS skills, City Councils or Research institutions frequently have a GIS specialist. The user groups targeted by SIAC that include primarily research/academia as well as practioniers, e.g., from local UF-NBS management or NGOs, are expected to be able to handle the complexity of SIAC use.
- The indicators support both research and planning, with some specific limitations related to carbon sequestration and the regulation of air quality. Here, trade-offs become apparent between (case-desired) accuracy on the one hand, and (data-dependent) generalization of assessments needed to promote tool transferability.
- Other suggestions for better integration of data or specific comments related to some sections have been resolved in the last months (i.e. how to introduce species data, when available; cities with good datasets would benefit of this tool; cities with less data may be most benefitting from SIAC, as they can approximate conditions/benefits roughly with minimal data).

3.3. SIK-Hub

The SIK-Hub testing was made mainly by researchers, which special emphasis on existing data (in Barcelona). Testing scenarios were used in some specific cases (i.e. “Visualise and download the data for walkability in Barcelona”). Testing followed the tool logics and narrative and it is detailed bellow.

Testing SIK-Hub – feedback summary (September, 2023)

SIK-Hub has a friendly and appealing interface, inviting the users to explore the data on urban trees and forests and providing an excellent database, methods explanation and storytelling. It also allows exploring other tools and it successfully integrates other CLEARING HOUSE outputs. The tool follows the concept and narrative presented in previous meetings and during the mock-up workshop. It also integrates data on ecosystem functions and specific demands (i.e. perceptions), providing a realistic and meaningful “data lake” for a broad public. SIK-Hub fills datagaps, especially related to more local spatial scales and brings an inclusive view on indicators.

It is successfully designed for a large array of users (stakeholders), integrating both robust scientific indicators and clear explanation for a broad public (i.e. Explore the story behind indicators). It allows indicators to become more operational (i.e. for planning) and at the same time they are transformed at a more human scale view (better visualized and understood).

Overall view on functionality and design

- The tool was easy and quick to access .
- From the very beginning, the design caused a strong, positive, impression.
- The tool is user-friendly and the sessions are clearly structured.

Choose an indicator

- Indicators for Barcelona are adequately used, analysed and displayed (maps). Both Table and Graphic on the right are helpful and informative.

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Explore the story behind indicators

- This part provides a very pedagogic and documented information related to the visualized indicators (data). The pictures accompanying the text are very well chosen and the text is comprehensive for the large public.
- The story maps are indeed very helpful to understand what data displays, which make this tool highly inclusive. That is, opening the data (indicators) to a large public, beyond the scientific community or administration.
- For each section, where needed, possible improvements were suggested. These were related to minor issues, such as graphic interface, page loading or path links, which have been improved in the last months.

Learn about connectivity

- This section contains more specific and technical definitions on indicators (i.e. ecological connectivity) and bibliographic references.
- This part seems specifically designed for researchers or administration (GIS background), and offers a good integration of research into the tool.

Learn about data and methods

- This section presents a nice and clear overview of the selected indicators.

3.4. City of trees

The results reflect the case of Barcelona. A total of 111 answers were received from the educational community from Catalunya, identifying the following main demands:

- Respondents reported the lack of materials to teach about forests and trees.
- Lack of green schoolyards and general difficulty in teaching youth in the outdoors (742% of the responses indicate the schoolyard to be little to not green at all. This is especially interesting, as teachers indicated to do most of their outdoors teaching out in the schoolyard (52%). The biggest barrier to teach outside was the lack of supervisors, which is indicative of the reasons why teachers opt to teach on the schoolyards that are little to not green at all. While 17% of the techers reported that their schoolyard to be mostly green, only 8% indicate their schoolyard to be entirely green.
- Lack of competences and skills to explain the importance of forests and the benefits of single trees in the cities.
- Just over a half of the teachers (51%) were happy with the materials that are available to them, while another half was not happy. Majority (43%) of those who reported to be happy about the materials, reported as source online materials. Over a quarter (25%) reported materials from a specific training or workshop they have attended. Twenty-four (24) individuals were happy with the materials distributed at the school and in the educational materials their school is using. Only 4 individuals reported any direct materials sent to the school on this topic to be a useful educational material for them.

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Summary of the schools demands for material related to urban nature (trees and forests)

Those who reported not to be happy about the materials, reported the following reasons (barriers) for their displeasure:

- Need more content in the text books, such as guides, posters, classification keys for plants more specific to the urban environment (of the city's parks and gardens, for example).
- More outings for students to get to know the trees, especially from the surrounding area, and to collect data. That would require small groups.
- The topic of ecosystems in general is very much underestimated in the high school curriculum. Other things are usually prioritized.
- Real and concrete material; more systematized material.
- Not abstract but material that is in context.
- Those of us who are not experts in trees, sometimes we do not have enough knowledge of what we have in our environment. It would be good for the city councils or educational services in the cities to send this information to schools.
- There is a lot of material that is specific to the location, but not made for teaching purposes.
- More material, spatial, knowledge resources ...
- Being able to touch it with your hands.
- More experiential. We make a punctual excursion, very theoretical, very general and not very cohesive.
- But it basically lacks a connection to reality to arouse the interest of some students who already go out little with their families (most).
- Being able to be in the woods.
- Activities and resources already designed and easy to apply in the classroom (or outside).
- Resources on how to take advantage of the forests on the outskirts or the trees of the city as a tool for direct learning. But devoting an excursion to studying only the trees is always unjustified and difficult to carry on.
- Have models close to towns and cities, find tools that allow more experiential learning.
- There are no tangible materials, I work with data.
- Being able to leave without having to ask for so many permits.
- Meaningful, visual and manipulative learning.
- Lack of material that generates interest, curiosity in students.
- More specific material.
- More manipulative materials. Adapted to the age of the students.
- Elaborated didactic units.
- More information in general.
- What I think would be needed is that there would be more teachers and that you could easily go to class in natural environments.
- I have to talk about human impacts on ecosystems.
- Guides for the trees around the institute.

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- To be able to do precisely field work, or to take classes outdoors. Bet on teaching more science and less content from memory.
- In high school these issues are not explicitly addressed.
- We treat it as a cross-cutting issue, they do it more in biology.
- Have material and do training.
- More practical cases for relating chemistry and physics to forests and trees.
- Access to nature or green spaces.
- More teaching material and more trees.
- An entire subject dedicated to nature protection and STOP pollution.

Box 3: A glimpse of responses related to the perceived benefits of outdoor teaching, received from the schools in Catalonia, Spain

- Childrens' attention changes, higher interest.
- More freedom of movement for students.
- Students peace of mind.
- The autonomy of some students.
- Learning, because then I can use that experience in class to remember concepts.
- Students like the change of scenery.
- Children enjoy contact with nature, direct observation enriches their learning.
- In nature and landscape drawing, visual stimuli.
- The atmosphere is more relaxed.
- Students are more receptive, ask more questions, can touch and see what you teach them, are in a more open environment, space ...
- The game, the discovery, the adventure work outdoors.
- Activities that involve movement.
- That you learn in a real context. You teach them to look at the world around them.

Once the educational material was developed (in English), **City of trees** material was translated in Catalan and terminology was reviewed by a researcher. The final version was first included for download in Green4children web and a webinar was presented in parallel. The webinar Naturalising the childhood, with participants from CLEARING HOUSE and the City Council of Barcelona (responsibles of Transforming the schoolyard strategy), registred more than 70 participants from schools from whole Catalonia.

The material was downloaded by more than 100 schools. However, due to the pandemics and difficult post-pandemic time for education, feed-back and evaluations from schools were difficult to achieve. One face-to-face workshop targeting the educational community in Barcelona, designed within WP3 and having as objective the feed-back of the educational package, was cancelled, due to busy period for teachers and general low interest for presential participation in post-COVID era.

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CONCLUSIONS AND THE WAY FURTHER

CLEARING HOUSE developed three tools for UF-NBS (a citizen science tool and two decision support tools) and one educational package (tool for schools). At the same time, the cities were guided by some partners in order to better adapt the tools and narratives to the diverging contexts (i.e. user-oriented tools, translation into local language in case of MyDynamicForest), raise awareness (dissemination, citizens engagement) and facilitate tools integration during specific workshop sessions (WP3 and WP4). Each tool was then tested and piloted in selected case studies, in real-word situation and with flexible methodology (protocols).

In addition, this section presents some *quoted testimonials* from the cities and various users, in order to evaluate the interest raised by various tools and the possible impact. The quoted testimonials are understood as written statements that either talk about their use of a product, its performance, its advantages, and the value witnessed. Actual or future users of the tools were asked to elaborate a short text around the following questions: (i) which of the tools would you see being adopted, e.g., by your institution/agency? (ii) any other comments, values, potentialities you wish to add. Some of the testimonials are presented bellow:

Eugènia Vidal, architect, Metropolitan Area of Barcelona (AMB), on MyDynamicForest:

> *"The AMB carries out different citizen science projects.These projects provide knowledge, disseminate and help raise awareness of the functions and values of our green infrastructure.The citizen science tool is a great opportunity to further involve our citizens in the knowledge and care of urban forests and trees in metropolitan parks. I could see this tool being adopted easily by AMB in the near future!"*

Agata Czaplarska, project assistant, The Sendzimir Foundation, Krakow, on MyDynamicForest:

> "*I think the MyDynamicForest is really an interesting tool. The users were surprised that they could mark their favourite places/problems on the map using a symbol and describe them. It was also really easy to find the survey using a GPS and I really like that only people near the park could fill in the survey (using GPS) because that was our goal to collect answers from the residents*."

Anonymous reviewer, on SIAC:

> *"The intended SIAC impacts (products, outputs) are suitable to support decision-making. This will be a very useful tool to have available."*

Anonymous reviewer, on SIK-Hub:

> *"The support of decision making based on multiple forms of data and multple levels of planning/decision is very important. What is extremely helpful is the combination of different forms of data; e.g the combination of qualitative and quantitive data."*

Júlia García Pastor, Fundació Catalana de l'Esplai, Spain, on City of trees:

> "*I work at the Department of Environmental and Emotional Education of Fundació l´Esplai, and I think it is a very interesting material to be able to work the environmental education and promote it among the teams of educational centers*."

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Montserrat Torres Maurí, Col·legi Santa Dorotea, Barcelona, Spain, on City of trees:

> *"I collaborate with the school's Sustainability Commission. I found this project very interesting and I will like to explore its possible use for the next academic year."*

Anna Romero, One Health Translations, Sant Pol de Mar, Spain, on City of trees:

> *"As an environmental educator, I'm launching a tree project and I'd like to take advantage of this package to inspire me. The webinar "Regreening the childhood" has been incredible, thank you very much!"*

To sum up, developing tools and piloting solutions in CLEARING HOUSE allows learning, operationalising and implementing the UF-NBS. Furthermore, the tools integrated the existing data and demand for knowledge identified along the project through various methodologies (co-learning workshops, contacts with field-laboratories in case-study cities, events, interviews, surveys, literature review). In order to maximise the impact and to include them in cities planning and agenda, further learning and motivational architecture and also exploitation actions will be needed in the cities, to go 'beyond CLEARING HOUSE'.

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