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Interdisciplinary analytical framework

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Summary

This deliverable includes the analytical framework for systematically and participatorily studying and implementing UF-NBS and their im-pacts on the urban socio-ecological system, including socio-cultural, ecological and economic aspects. Top-ics addressed by the framework will include ecosystem functioning, biodiversity, ecosystem services provi-sioning, impacts on human wellbeing (including socio-environmental justice, urban liveability, equality, social inclusion and gender and public health), climate change adaptation and the cost-effectiveness of UF-NBS in cities and their peri-urban surroundings. The framework will show the contribution of different disciplines through assigned thematic experts and give guidance for analysing existing planning instruments and monitoring schemes.

Approval

Date	By
2021-12-14 19:32:32	Dr. Rik DE VREESE (EFI)
2021-12-14 19:32:41	Dr. Rik DE VREESE (EFI)

D1.6
Development of an Analytical Framework for the CLEARING HOUSE case study research

Cover picture: Johanna Park in Leipzig, Germany (Photograph by Dagmar Haase)

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EXECUTIVE SUMMARY

This short report, referred to as Deliverable 1.6 (D1.6), is a *summary of key findings, an overview of, and a comparative perspective on relevant governance, institutional and economic frameworks in China and Europe for urban forests as nature-based solutions (UF-NBS)*. It bases on work realised in WP1 and on a Sino-European co-design event. In the context of UF-NBS and the CLEARING HOUSE project, urban forest patterns, governance structures, institutional and economic frameworks are interlocking at various spatial levels. Task 1.5 merges the key findings of the Tasks 1.1 to 1.4 together with the findings of the exploratory analysis of the case studies (Task 2.1 in WP2; da Schio et al. 2021) and the inputs gathered from the co-design process (Task 3.1; De Vreese et al. 2021) into an analytical framework for a systematic and participatory study and implementation of UF-NBS and their effects and impacts on the urban socio-ecological system, including socio-cultural, ecological, and economic aspects. Topics addressed by the analytical framework will include ecosystem patterns and functioning, tree- and biodiversity, ecosystem services provisioning, impacts on human wellbeing (including socio-environmental justice, urban liveability, equality, social inclusion and gender and public health), climate change adaptation and the cost-effectiveness of UF-NBS in cities and their peri-urban surroundings. The analytical framework will highlight the contribution of different disciplines through assigned thematic experts from CLEARING HOUSE and give guidance for analysing existing planning instruments and monitoring schemes. It is preliminary structured in four streams, for the purpose of splitting and organising the work in WP2 and in the case studies. All four streams are interconnected, both in terms of the theme they cover and in terms of the activities planned.

KEY WORDS

Nature-based solutions; urban forest; typology; best practice NBS; governance, Analytical Frameworks; CLEARING HOUSE

ABBREVIATIONS

CLEARING HOUSE (Project acronym)	Collaborative Learning in Research, Information-sharing and Governance on How Urban forest-based solutions support Sino-European urban futures
EU	European Union
NBS	Nature-based solution(s)
UF-NBS	Urban forests as nature-based solution(s)

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VERSION HISTORY

Version	Date	Author(s)	Partner	Description
1.0	30/09/2021	Haase, D., de Schio, N., Davies, C., Jin, J., Basnou, C., Tyrväinen, L., Wolff, M., da Schio, N., Lafortezza, R., De Vreese, R., DeBellis, Y., Scheuer, S., Chen, W., Schante, J., Bergier, T., Winkel, G., OTHERS	HUB as lead and many others	Part complete written draft for comment and feedback by CH team and final submission as living document.
1.1	30/11/2021	Rik De Vreese	EFI	Review and update of references and literature list.

REFERENCE

Haase, D., de Schio, N. Davies, C., Jin, J., Basnou, C., Tyrväinen, L., Wolff, M., Lafortezza, R., De Vreese, R., DeBellis, Y., Scheuer, S., Chen, W., Schante, J., Bergier, T., Winkel, G., OTHERS. 2021. *Development of an Analytical Framework for the CLEARING HOUSE case study research (D1.6)*. H2020 project CLEARING HOUSE, agreement no. 821242.

ACKNOWLEDGEMENTS AND CONTRIBUTIONS

We would like to express our gratitude to all the contributors from WP1 and the case studies who took their time to collect information for this analytical framework.

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Box 1: Urban forests and trees – Definitions

Nature-based solutions (NBS): Nature-based solutions (NBS) are defined as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (IUCN, 2020).

Urban forestry: the integrated and multidisciplinary approach to planning and managing all forest and tree resources – ranging from street trees to peri-urban woodlands – in an near urban areas. (Konijnendijk, Nilsson, Randrup, & Schipperijn, 2005)

Urban forests: tree-based urban ecosystems that address societal challenges, simultaneously providing ecosystem services for human well-being and biodiversity benefits. Urban forests include peri-urban and urban forests, forested parks, small woods in urban areas, and trees in public and private spaces. (Escobedo, Kroeger, & Wagner, 2011; FAO, 2021)

Urban tree(s): usually long-living woody organism(s) including woody shrubs, frequently single stemmed, with the potential to grow at a site in an urban or peri-urban area. Examples include roadside trees, trees in square or in parking areas, in parks and private gardens. Urban trees appear as individual or as groups of trees.

Urban forests as nature-based solutions (UF-NBS): a subset of nature-based solutions, that build on tree-based urban ecosystems to address societal challenges, simultaneously providing ecosystem services for human well-being and biodiversity benefits. UF-NBS include peri-urban and urban forests, forested parks, small woods in urban areas, and trees in public and private spaces. (European Forest Institute, 2018)

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1 INTRODUCTION

1.1 CLEARING HOUSE project

"Collaborative Learning in Research, Information-sharing and Governance on how urban forest-based solutions support Sino-European urban future" (CLEARING HOUSE), funded through the European Union's Horizon 2020 (H2020) research and innovation programme, is a four-year long research project (2019-2023) and designed to address global challenges such as climate change, human well-being, and the deterioration of ecosystem services. These challenges have arisen from the cumulative impact of rapid urban growth, economic development and unsustainable consumption and are amplified in urban areas through notable socio-economic and demographic challenges, such as ageing populations, migrations flows, social and economic segregation (see SDG 11).

The CLEARING HOUSE H2020 project unites European and Chinese cities and researchers in adopting a co-design approach in their quest to develop more resilient and liveable cities. To do this, CLEARING HOUSE is exploring urban forests as nature-based solutions (UF-NBS) for the cost-effective restoration of degraded urban and peri-urban environments and the enhancement of ecological connectivity. The aim is to improve human wellbeing and social inclusion and create better conditions for biodiversity and the delivery of ecosystem services such as clean air, microclimates, and aesthetics.

1.2 Work package 1

Work package (WP) 1 is one of six work packages in the CLEARING HOUSE project. The main purpose of WP1 is to review knowledge and develop analytical concepts. It does this by identifying existing UF-NBS, developing a novel UF-NBS typology, reviewing available best practice experience and knowledge and data related to the design, implementation, and impact of UF-NBS. This has been conducted through surveys of societal perceptions, an analysis of the governance, institutional and economic frameworks shaping and impacting UF-NBS, and the development of an interdisciplinary analytical framework for the CLEARING HOUSE WP2 for a Sino-European case study analysis.

1.3 Purpose of this deliverable

This short report, referred to as Deliverable 1.6 (D1.6), is a short report on the *Development of an Analytical Framework for the CLEARING HOUSE case study research*. It also feeds into a Sino-European co-design event. In the context of UF-NBS and the CLEARING HOUSE project, forest patterns and tree-based ecosystem services on the one hand, and governance, institutional and economic frameworks on the other are interlocking at various spatial levels along an urban-periurban gradient.

1.4 Objective of CLEARING HOUSE Task 1.5 (leading to D1.6)

Task 1.5 to be reported about here merges the key findings of Tasks 1.1 to 1.4 together with the findings of the exploratory analysis of the case studies (T2.1, da Scio et al. 2021) and the inputs gathered from the co-design process (T3.1, De Vreese et al. 2021) into an analytical framework for systematically and participatorily studying and implementing UF-NBS and their impacts on the urban socio-ecological system, including socio-cultural, ecological, and economic aspects. Topics addressed by the framework thereinafter include ecosystem functioning, biodiversity, ecosystem services provisioning, impacts on human wellbeing (including socio-environmental justice, urban liveability,

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equality, social inclusion and gender and public health), climate change adaptation and the cost-effectiveness of UF-NBS in cities and their peri-urban surroundings. The analytical framework clearly identifies the contribution of different disciplines through assigned thematic experts from the CLEARING HOUSE consortium and give guidance for analysing existing planning instruments and monitoring schemes.

T1.5 was realised in several consecutive steps including the core findings of WP1 so far, a novel UF-NBS typology, a new repository for scientific knowledge on UF-NBS, best practice examples and projects implemented in Europe and China and UF-NBS governance and financing schemes (**Figure 1**). The following steps were undertaken: First, an online workshop with a core group of project partners (UNIBA, HKU-SIRI, HUB, CAF-RIF, VUB, EFI, MD2, UniLodzki, LGI, CFRI, CREAF, LUKE) was organised to develop a screening tool (D1.5, Scheuer et al. 2020) for the exploratory analysis of the case studies in T2.1. The screening tool (Scheuer et al. 2020) encompasses analytical questions from all disciplines as outlined in T2.1. and assigns responsible research partners for their analysis. Subsequently, informed by the findings from the case study screening (T2.1, da Schio et al. 2021), the report from the local co-design workshops (T3.1, De Vreese et al. 2021) and the findings from T1.1-1.4 (see above), T1.5 elaborated a draft proposal for an Analytical Framework (M1.7) to conduct T2.2. This draft has been intensively discussed with all project beneficiaries, the stakeholder mirror group (see T5.2) and the user advisory group (T5.5) during the Sino-European co-design event (T3.1: M3.2). The analytical framework has been revised (this document D1.6) and will be subsequently be used in T2.2 for the in-depth analysis of the case studies as described there. It is a living document and will take up experiences made in the comparative case study work in WP2 and reflect upon these during the remaining life cycle of CLEARING HOUSE.

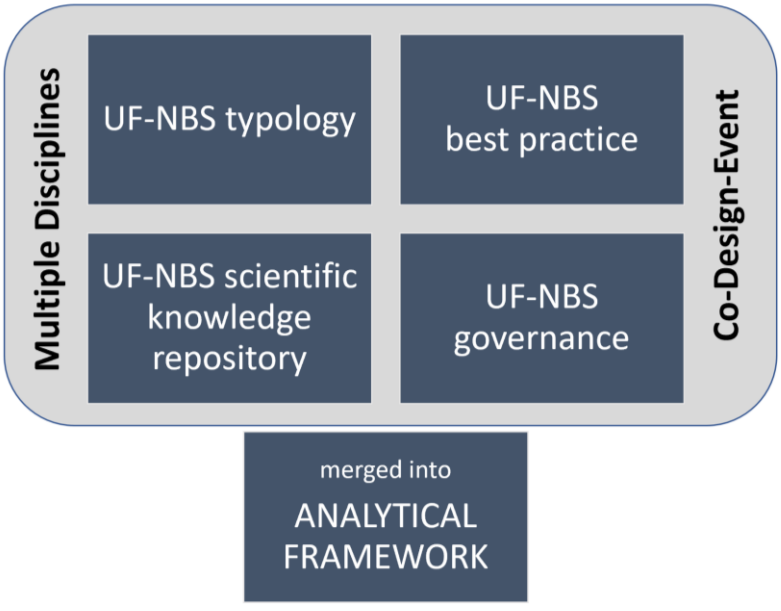

Figure 1: The “ingredients” for the elaboration of the Analytical Framework: Elaborated and systematised knowledge about UF-NBS as the core result of WP1. The framework serves as a kind of “hand over” from WP1 to WP2 in CLEARING HOUSE

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2 COMPONENTS OF THE ANALYTICAL FRAMEWORK

2.1 A novel standardised Sino-European UF-NBS typology

The first ingredient into the Analytical Framework, the CLEARING HOUSE typology of urban forests as nature-based solutions (UF-NBS), conceptualizes entities relevant to UF-NBS. To do so, elements of the green-blue infrastructure (GBI) are defined in the typology. Contrary to purely textual representations of knowledge, CLEARING HOUSE proposes a definition of GBI elements through traits, i.e., characteristic and defining morphological, physical, functional, and institutional attributes, including for example the composition, spatial grouping, and topology of UF-NBS elements, and the ecosystem services and benefits provided them.

CLEARING HOUSE proposes a semantic approach to express this knowledge, i.e., a formalization of knowledge as an ontology using the Web Ontology Language. Such ontologies are machine-interpretable series of statements of facts to define a taxonomy (or a vocabulary). The definitions of GBI elements are embedded within a formalization of overarching concepts, particularly, of urban forest, nature-based solutions (NBS), and of UF-NBS. Here, urban forest is conceptually understood as the entirety of trees within an urban-ecological system. NBS are perceived in CLEARING HOUSE as an overarching concept that embraces natural and semi-natural elements of the GBI such as forests, engineered solutions such as permeable pavements, as well as actions inspired by nature. UF-NBS are then conceptualized as the intersection of the two previous entities, i.e., as the intersection of urban forest and NBS, and thus include any tree-related NBS (**Figure 2**).

The proposed typology provides the grounding knowledge of the comparative case study analysis to be conducted by CLEARING HOUSE and will serve as a basis for the development of the CLEARING HOUSE benchmarking tool and thus as a base for our Analytical Framework.

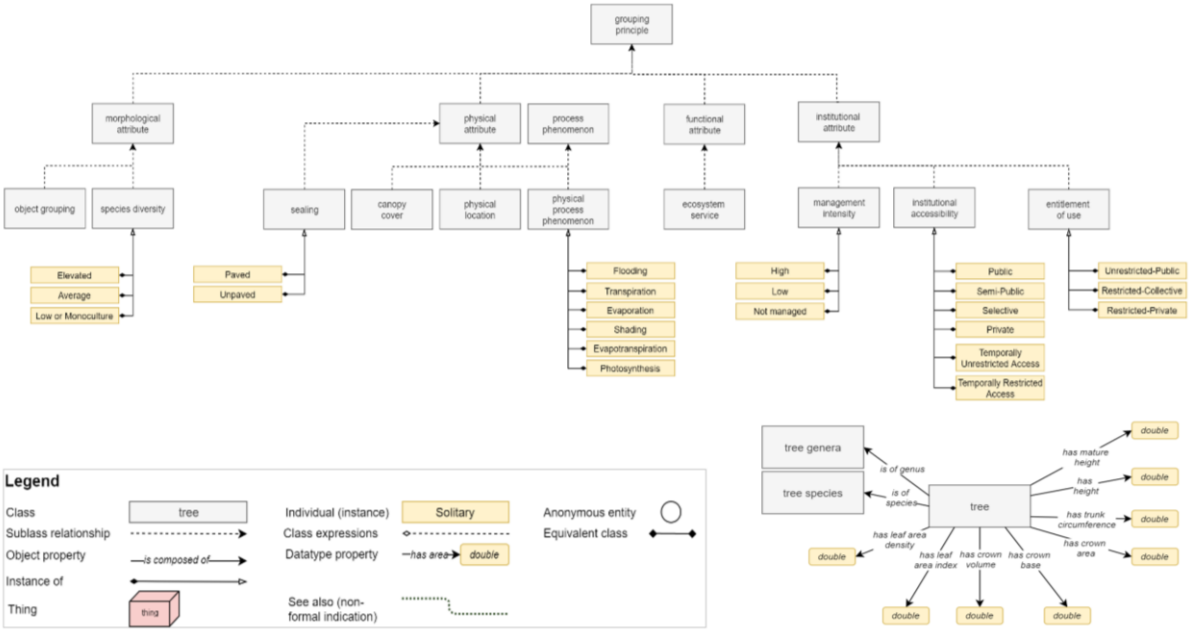

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Figure 2: Identifying and mapping UF-NBS and developing a respective typology with classes, individuals, objects and instances (Scheuer et al., 2021a)

2.2 UF-NBS for European and Chinese resilient cities

The second ingredient into the Analytical Framework is a structured interpretation and evaluation of the current knowledge used to collate evidence on intended outcomes and unintended impacts of UF-NBS for urban ecosystem regeneration and human wellbeing. The information reported herein is based on the compilation of a reference-recorded knowledge repository of UF-NBS and their impacts on urban liveability, public health, halting biodiversity loss and re-diversifying UF-NBS structures to enhance urban resilience (see section 2.1). The best-practice knowledge base provides a comparative analysis of case histories, providing conclusive insights into common or contrasting aspects in and between these two continents. Final considerations drawn from the comparative analysis of the intended outcomes of UF-NBS implementation include lessons that can be learned and existing knowledge gaps. A Sino-European analysis, in the form of a modelling exercise, was conducted of the selected case histories to explore shared themes, such as connectivity, multifunctionality and social cohesion, and macro-categories (i.e., ecological, engineering, social and economic macro-categories) for urban regeneration and renaturing.

Key findings included in the Interdisciplinary Analytical Framework could be summarized as follows:

(1) elaboration on the role and importance of UF-NBS in both world regions,

(2) high importance of health, well-being and quality of life in line with SDG11,

(3) elicitation of well-established UF-NBS types (trees, forest-type [peri-]urban landscapes) and actions (forest/tree monitoring) as well as shortcomings (lack of differentiation of tree genus or tree species, public perceptions and expectations),

(4) strengthen multifunctionality (Europe: health benefits, noise attenuation, food provisioning; Eastern Asia: degraded soils) and avoid negative effects (Eastern Asia: loss of biodiversity and habitat; Europe: damages to infrastructures and built-up elements), as well as

(5) a need to develop a better understanding of the differences between the world regions and divergences of the findings of the academic review and grey literature review.

2.3 Reviewing the knowledge on the importance of UF-NBS for resilient cities

The third ingredient into the Analytical Framework, a review of academic literature about UF-NBS is a key analytical tool for the creation of an evidence base on the impacts of UF-NBS on urban liveability, public health, biodiversity, and ecosystem services. The screening of academic literature based on a set of eligibility criteria resulted in an identification of 422 relevant records, that were analysed through a rapid review process. This analysis of records focused on selected key aspects including geographic context, nature-based solutions context, i.e., action conducted and/or type of corresponding green element studied, observed impacts, i.e., benefits/ecosystem services as well as ecosystem disservices, and research context including societal, economic, or environmental challenges addressed, as well as methods and data used.

Key findings. Reviewed records focused on 67 countries, predominantly located in the Americas, Europe, Asia, and Australia. Fifty-nine (59) unique types of green elements were identified, with urban

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and peri-urban (riparian) forests, parks, street trees, and residential green most often mentioned. The most frequently described actions include monitoring actions; greening, afforestation and reforestation, ecosystem management, species diversification, and restoration actions; however, a significant number of academic records does not study a specific intervention. Common challenges providing the context of case studies include nature conservation and restoration, the management of green spaces, support of sustainable development, decision-making and planning, the improvement of public and human health and well-being and of the quality of life, and mitigation and adaption action. Benefits most often targeted or identified include the maintenance of biodiversity, the provisioning of recreational opportunities and restorative potentials, the increase of amenity values, the regulation of air quality and of temperature, thermal comfort, and humidity (**Figure 3**; Scheuer et al., 2021b).

Figure 3. Examples of the repositories' dashboard elements. (a) Key indicators for aggregate statistics, e.g., number of relevant records, identified ecosystem services, number of records per year; (b) references, linked

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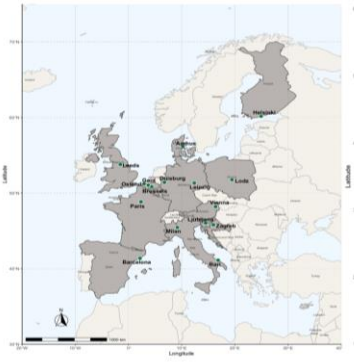
to the publication via its DOI; (c) Sankey chart for the summarization of variables, and an at-a-glance overview of relationships between the different categories of reviewed variables; (d) mapping of case studies in the form of a choropleth map combined with local chart signatures; (e) customizable summarizations; (f) use of various chart types across the dashboard, including, e.g., sunburst charts, that allow data drilling (adapted from Scheuer et al., 2021b).

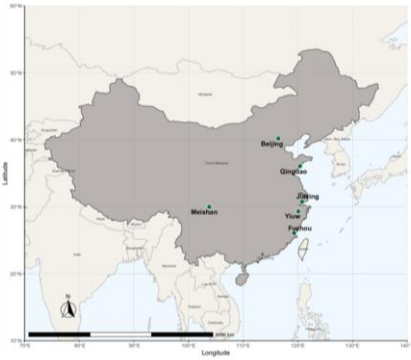
A pilot Sino-European comparison has been conducted in addition, to identify similarities and differences in the aforementioned analytical aspects more specifically between Europe and Eastern Asia/China. Furthermore, on the basis of these findings, a set of research questions has been identified for further consideration within the CLEARING HOUSE analytical framework.

To ensure a rapid dissemination of findings, and to allow researchers and stakeholders access to these findings under their own analytical lenses, an interactive online dashboard has been developed. This dashboard can be accessed at http://review.clearinghouseproject.eu.

2.4 Analyzing governance, institutional and economic frameworks for UF-NBS

The fourth ingredient into the Analytical Framework is an in-depth analysis of governance, institutional and economic frameworks, and schemes for UF-NBS in Europe and China. It bases on a series of pandemic-related virtual workshops that defined workplan and a case history template. The case histories represent new data collected by CLEARING HOUSE researchers from key informants and shared by T1.2 (**Figure 4**). Particular attention was paid to multi-level and networked governance dynamics in relation to urban development, and contextual differences. T1.4 determined that economic, institutional and governance frameworks can be interconnected as shown by Liefferink (2006). In CLEARING HOUSE, stage 1 focuses on the project level. Case histories are 'projects' using UF as a NBS (project managers do not always use the term NBS) and 'histories' was used to differentiate with the ten CLEARING HOUSE case studies.





Planning family	Key word description	Countries	22 case histo-ries
British	Land use planning.	United Kingdom	1
Central	Regional economic planning	Austria, Germany, France, Belgium, France	7
New Member States	Post socialist	Poland, Slovenia, Croatia	3
Mediterranean	Urbanist and rigid	Italy, Spain	3
Nordic	Comprehensive and integrated	Denmark, Finland	2
Chinese	Centrally derived	China	6

Figure 4: Map of case histories in Europe

Key findings

1. **Similarities between continents.** The engagement of the private sector is under-developed. The funding of UF-NBS relies to a high degree of municipal funds and this might stifle innovation and business involvement. Resourcing of the 'post creation phase' management is not always clear, especially when it comes to long-term revenue funding. UF-NBS is a new term in both continents and understanding of what it means and implies at the project management

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level is generally low or absent - the term Urban Forestry is extensively used in most (but not all) case histories, so we are half-way there. Ecosystem thinking is evident in both continents – this is encouraging. Public engagement and co-governance in decision making and project control is limited or absent and engagement tends to be 'top down'.

2. **Differences between continents.** The scale of ambition and the ability to access capital funding may be less problematic in China than Europe (although both continents experience difficulties in securing land at a reasonable price). Assembling funds to start a project in Europe may be more complex and hence slow in comparison with China which means that the lead time from conceiving a project to starting its implementation in EU may take longer. There may be more citizen engagement in UF in Europe than China, but it is erroneous to say that citizen engagement is not present in China and is being positively encouraged in some cases. Europe does not have an equivalent of the Chinese Forest Cities program. Project managers in Europe report more on funding shortages and short-termism. Design, implementation, and management of the UF-NBS is dependent on the social, cultural, and economic context.

The engagement of the civil society (social groups, citizens) is still relatively low, ergo a top-down approach is dominant, with the leading role of municipalities. We see a need for widening the scope of the co-design processes involving residents and various citizens groups. The engagement of the private sector seems to be still falling short of expectations and the funding of UF-NBS relies to a high degree on municipal funds. This may: (1) strengthen top-down governance arrangements with public participations, (2) impose institutional arrangements where citizens are recipients, not co-owners and co-makers of proposed solutions and (3) reduce the scope of innovations for economic frameworks and possibly limit the involvement of private sector. There is little to suggest that the governance of UF-NBS is any different to the governance of other forms of NBS. Indeed, support can be found from the findings of Xie and Bulkeley (2020) who reported that whilst local planning processes are assumed to be the instigator of urban NBS, for European cities project-based actions are presently preeminent.

Recommendations for issues to be taken up by the Analytical Framework:

1. The study of governance, institutional and economic frameworks has revealed significant opportunities for future research.
2. In both continents a process of reflection and mutual learning is needed to enhance the role of citizens in UF-NBS.
3. Those involved in funding decisions should ensure that long-term management after implementation is fully accounted for in project planning.
4. Mechanisms for the engagement of non-governmental sources of funding need to be fully understood and enhanced if the private sector and other means of securing resources are to be successfully applied.
5. Europe does not have a direct equivalent of the Chinese Forest Cities. Europe can learn from this and institute a culturally appropriate equivalent and learn from China's key performance indicators.

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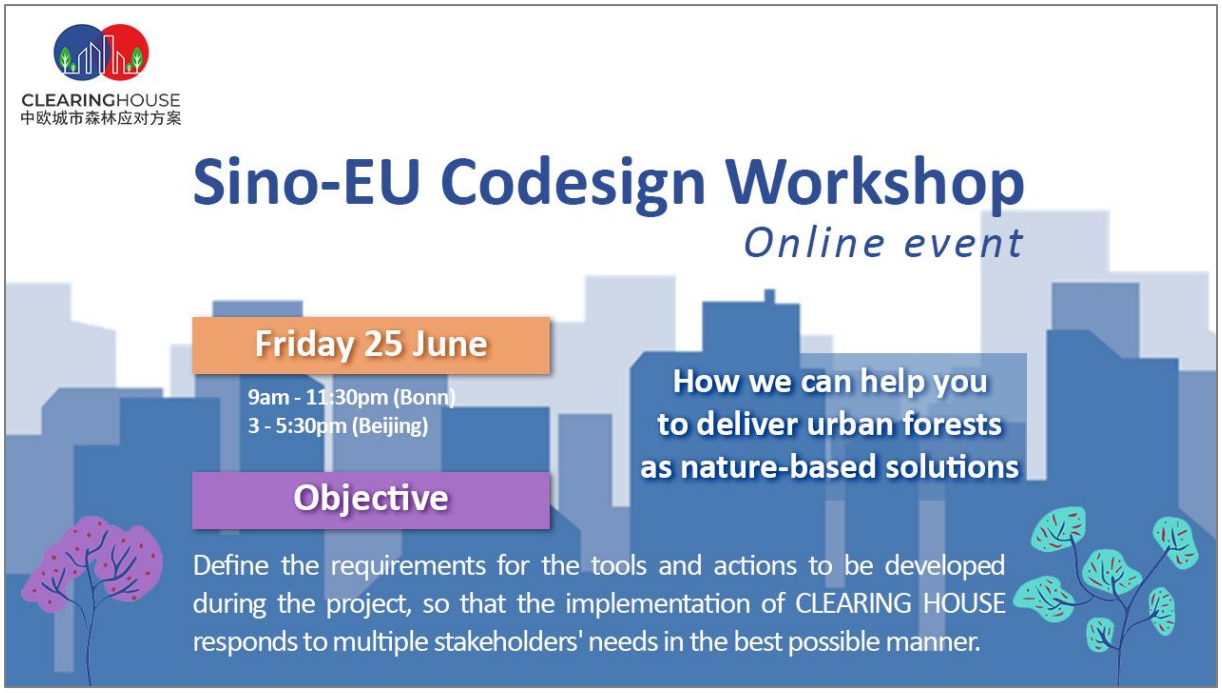
3 SINO-EUROPEAN CO-DESIGN EVENT

Due to the COVID-19 pandemic, the co-design event (M3.2) in the CLEARING HOUSE design of works which would have been held over several days as a present in person event was split into two half-day on-line events. The co-design event was used to co-develop the core questions for the Analytical Framework guiding phase two of CLEARING HOUSE. The co-design event used a MURAL board for a participatory design and development (see **Figure 5**, see also Whittlesey et al. 2021). A large group of CLEARING HOUSE partners came together as well as stakeholders from the case studies. **Figure 5** shows among others the results of the Mural online discussion being the base for classifying partner input into the four research streams introduced in section 4 of this document.



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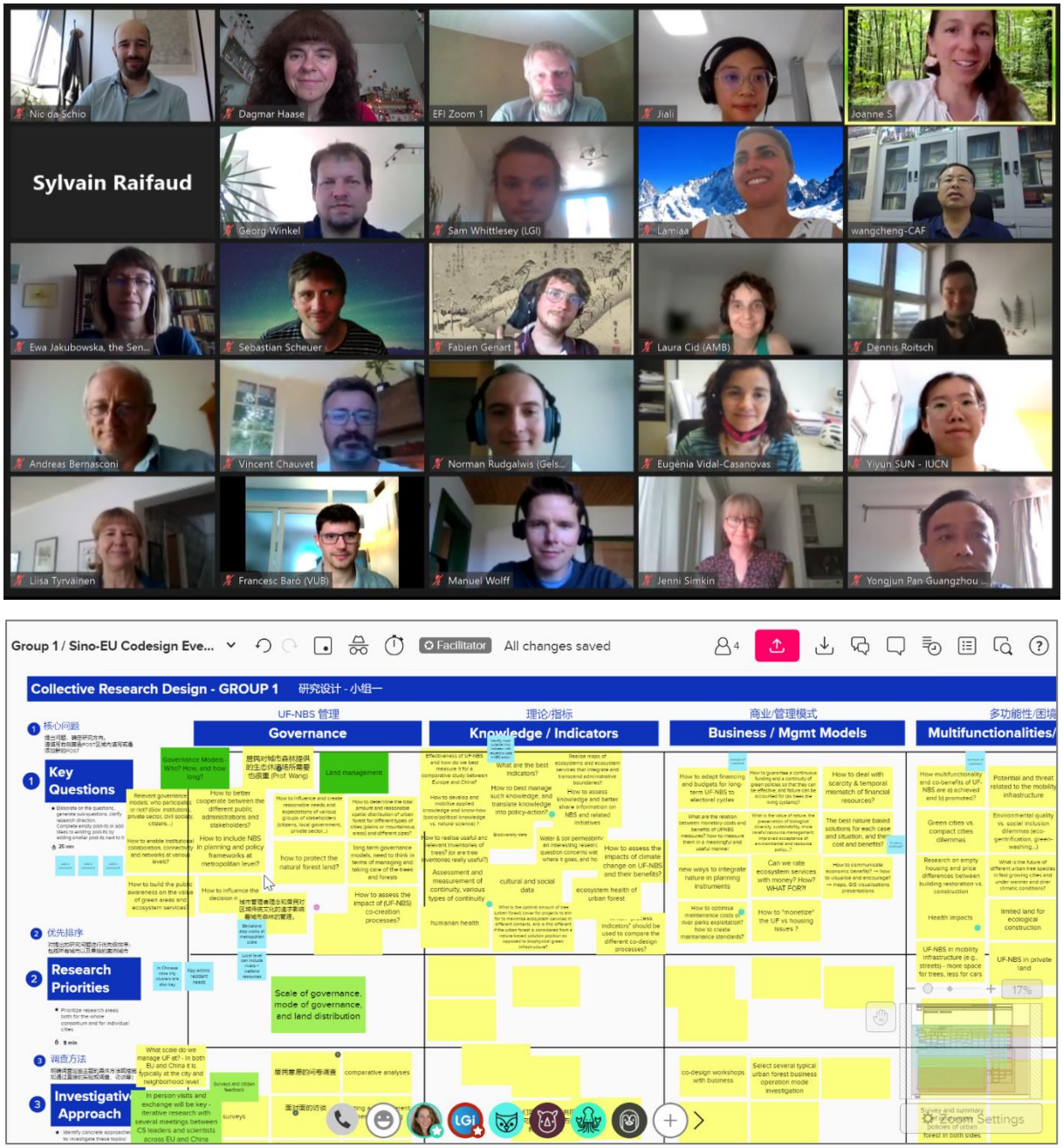

Figure 5. The Co-Design event in June 2021: Invitation, participants and resulting Mural on which the following core questions and the research streams for and of the Analytical Framework introduced in section 4.

4 AN ANALYTICAL FRAMEWORK FOR A COMPARATIVE CASE STUDY ANALYSIS IN WP2

4.1 Input: Core questions developed based on the findings of WP1

Governance

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- How can co-design of UF-NBS be enhanced: is co-design and co-governance realistic and beneficial to ES delivery of UF-NBS? Does co-design lead to increased social acceptance? (T1.4)
- What strategies can be developed to build the capacity of/and diversity of stakeholders to contribute to UF-NBS enhancement? (T1.4, Brussels)
- How to facilitate "desirable needs and expectations" from various groups concerning sustainable development of parks? (Krakow)
- How to find common ground for prioritisation of biodiversity, ES, functions & NBS at various administrative levels? (Barcelona)
- How to work with the silosity? (Krakow)
- How to overcome short-terminism? (T1.4)
- How to engage/support private owners, tenants and cooperatives of (urban/peri-urban) green space to conserve trees on their property, to grant public access to private UF-NBS, or to include UF-NBS in their designs and developments? How to cope with resistance against protecting trees on private land? (Brussels, Leipzig, Krakow; T1.4)
- Which regulatory and legal frameworks are necessary for protecting UF-NBS at private land and/or making UF-NBS at private land accessible? (T2.1)
- Which governance arrangements exist in relation to the planning, design and implementation of UF-NBS in Europe and China?
- What are lessons-learnt from different governance arrangements in urban regions in Europe and China? What are differences between the governance arrangements?
- Which actors, institutions and resources are part of the UF-NBS design and implementation?
- Which indicators for stewardship strategies - success & failure indicators & arguments are available? (T1.2b)
- How are UF-NBS and their implementation processes framed? (T1.2b)
- Is the creation of new project organisations with significant local participation/stakeholder participation important for ES delivery? (T1.4)
- Can change management in institutions lead to enhance multi-level and networked governance dynamics? (T1.4)
- How to work with ecosystem boundaries versus administrative boundaries (T2.1)
- Where do conflicts occur and where to act? (case study Krakow)

Cultural ecosystem services & citizen appreciation of UF-NBS

- RQ1: How do different societal groups in the cities perceive UF-NBS and how to integrate these perceptions in design, management & ES delivery? (T1.2)
- RQ2: How do perceptions and ES demand - based on participatory mapping - differ between case study cities and between societal groups?
- RQ3: Can citizen science be applied as an awareness raising tool to mobilise citizens for UF-NBS , with special attention towards the use of the tool by less-privileged groups?

Sustainable funding mechanism for UF-NBS & cost-effectiveness

- Build the evidence base for cost-effectiveness of UF-NBS (T1.2)

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- What is the potential of public-private partnerships (investment/payment/PES) in UF-NBS implementation, restoration, and management/funding through development consents/permits? (T1.2; Gelsenkirchen)
- What is the potential for CSR (incl. tree adoption, workplace volunteering, tree awards) as frame for investing private resources in UF-NBS? (T1.4)
- How to work with the temporal mismatch between short-term funding/electoral cycles and long-term ES delivery? (T2.1) – the mismatch between finding easily budget for tree planting vs the difficulty in finding management budget is illustrative for this
- How to fund UF management & maintenance; how to minimise management costs? (T1.2b; Gelsenkirchen, Leipzig, Krakow, Guangzhou-Shenzhen-Hong Kong)
- How to engage businesses and other private partners in UF-NBS management (Krakow, China?)
- How to promote the UF-NBS business model? (Beijing, Hangzhou)
- How to communicate economic benefits by UF-NBS? (Krakow)
- How can NBS/ES be integrated into cities' accounting? (resulting from the co-design meeting)

Geography of UF-NBS / Multifunctionalities

- What is the optimal tree cover to maximise ES delivery in different contexts? (T1.2a)
- How to plan UF so that the distribution is more scientific and reasonable? (Hangzhou)
- What is the best nature-based solution for each case and situation, and what are their cost and benefits? (Barcelona)
- Which species (or vegetation) could be more resilient to the changing conditions under climate change (T1.2b, T2.1 local co-design workshops; Barcelona, Gelsenkirchen, Leipzig, Beijing, Guangzhou-Shenzhen-Hong Kong, Hangzhou, Xiamen)
- Management strategies for strengthening the adaptive capacity of trees regarding climate change while maintaining their multiple benefits (T1.2b)
- How to assess trade-offs between ES (incl. UF-NBS versus commercial forestry), between NBS? (Gelsenkirchen)
- How to include mobility infrastructure as a facilitator for green corridors and to increase accessibility to urban green space? (T2.1; Brussels)
- Can Park Streets and re-greened semi-public spaces as sports facilities play a role as ecological corridors? (Brussels)
- How to integrate UF-NBS with local developments? (Gelsenkirchen)
- How to deal with the forest-water nexus and water management as a driver for UF-NBS? (T1.2a, RQ2)
- How to design and manage UF-NBS as health- and well-being supporting ecosystems? (T1.2a)
- How to use monitoring for UF management? (T1.2b, RQ1)
- What are management strategies for increasing adaptive capacity to improve tree health? (T1.2b, RQ1)
- How to improve the urban growing conditions (soil, water, sunlight) to prevent tree mortality? (T1.2b, RQ1)

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- Which biophysical and functional traits of forests and trees contribute to ecological connectivity? (T1.2b, RQ4)
- From a connectivity perspective, is densification or greenfield development preferable? (T2.1, RQ2)
- What is the role of trees and forests as connectors to stop landscape fragmentation (Barcelona)?
- How to connect private and public green space? (Brussels)
- How to create animal-friendly green and grey infrastructure? Which connections for which plant/animal species? (Krakow)
- How to survey spatial connectivity? (Krakow)
- How to increase ecological stability and species diversity (Hangzhou)?
- How to use natural succession/natural regeneration in urban forests (Leipzig, Xiamen)?

4.2 Analysis streams co-developed by WP1 and WP2

Resulting from both, WP1 input and the research questions listed in section 3.1, a "four streams" Analytical Framework has been co-developed with WP2 which is presented in the coloured scheme below. It has two purposes: systematising and organising the work in WP2 and the case-study related activities in CLEARING HOUSE. The four streams are interlinked in topical terms but also in terms of the teams working in the streams and methods used/applied.

1. Governance Analysis: UF-NBS and transdisciplinarity	
Broad research objective	Explore and understand how to successfully cooperate across stakeholders to enhance UF-NBS provision (i.e. actors within the government, non-governmental stakeholders, citizens...). In particular, the research stream will analyze barriers and challenges for governance/policies, effective implementation, potential and desired outcomes, and new models of successful cooperation within and between institutions and with institutional and non-institutional stakeholders. The work will also focus on the role of bottom-up processes and stewardship strategies. Particular attention has to be paid to dynamic of capacity building and inclusion of less privileged groups (including gender aspects, aspects of environmental justice).
Nature of the task	The task includes both a comparative analysis across all case study cities, as well as a zoom on specific questions at the level of individual cities, and/or selected pairs (how can co-design of UF-NBS be enhanced: is co-design and co-governance realistic and beneficial to ES delivery of UF-NBS? Does co-design lead to increased social acceptance? How to connect environmental protection agency with mobility agency?)
Coordinator	Nicola da Schio, VUB

2. Cultural ecosystem services & citizen appreciation of UF-NBS

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Broad research objective	The objective of this task is to get insight in the potential of using citizen science (incl. participatory mapping) to map societal perceptions and demands towards UF-NBS in the case study cities. We will also assess the potential of citizen science as an awareness raising tool to mobilise citizens, with special attention towards the use of the tool by less-privileged groups to seek an appropriate representation of all social groups in the city. The comparative aspect of the research looks in the diverging perceptions and demands between the case study cities, but also between different societal groups. The results will also be related to the availability of forests and trees in the neighbourhoods (building on T 2.1).
Nature of the task	This task is the research complement to task T3.3 on developing and implementing a citizen science monitoring tool, that is engaging citizens in the assessment and mapping of UF-NBS and monitoring their socio-ecological impacts, with a focus on (localising) CES and intangible ES. The work in this stream will also build on the outcomes of the Sino-European societal survey with regards to biographic and socio-cultural attributes of citizens, and assessing their demands towards UF-NBS.
coordinator	Corina Basnou, CREAF

3. Sustainable funding mechanism for UF-NBS & cost-effectiveness	
Broad research objective	How to ensure sustainable funding and management of UF-NBS, from both private and public sources? How to document and market the cost-effectiveness and the (monetary) benefits of UF-NBS?
Nature of the task	This task is very closely related to T4.1. T4.1 is on developing and testing the business models, T2.2 is doing the research towards barriers and facilitators for SBM for UF-NBS. The work on the cost-effectiveness is a shared responsibility of T2.2 and T4.1.
coordinator	Lamiaa Biaz (LGI)

4. Geography of UF-NBS / Multifunctionalities	
Broad research objective	**Geography/Spatial distribution** • Long-term trends of UF patterns: How are urban tree system distributed (heterogeneity)? How are they connected/fragmented (connectivity)? How are they related to socio/spatial characteristics and other environmental characteristics? • How do urban tree systems interact with other natural (i.e., water, air) and built forms (buildings and grey infrastructure) in urban areas

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	and do these provide a multiplication or subtraction of nature-based benefits. • How are urban tree systems linked to peri-urban tree systems and to rural systems beyond and what connectivity benefits accrue from this. **Multifunctionality** • If all projects under scrutiny focus primarily on the provision of UF-NBS, they touch -intentionally or not- on a number of other themes, including other ecosystem processes, uses of public space, public health, mobility. Positive interconnections are observed where the provision of UF-NBS does/can strengthen the provision of other socioecological goods. In other, conflicting priorities emerge and the provision of UF-NBS does/can inhibit the provision of other socioecological goods, or even cause emerging negative externalities. • What are the other themes that emerge in a given context? Do they give rise to synergies and virtuous circles or to dilemmas about what issue to prioritize and conflicts between different visions of the city? What are existing synergies and conflict? How do cities deal with emerging dilemmas?
Nature of the task	Short research pieces focusing on individual dilemmas such as green/mobility, green/gentrification, leisure/biodiversity, greenfield/densification, green/blue network • Study on UF fragmentation in Europe and China (online meetings/workshops and data work) • Study on tree vulnerability and susceptibility to CC (online meetings/workshops and data work) • Study on the nature-based solution benefits of urban forest connectivity to tree systems outside of the urban area.
Coordinator	Dagmar Haase (HUB)

5 CONCLUSIONS

The Analytical Framework as it is presented in this document leads CLEARING HOUSE from the basic knowledge compilation and structuring in WP1 to an in-depth case study analysis in WP2 reflecting the state of knowledge about UF-NBS in science, at local level, within regional and local policy documents and at project/implementation level for Europe and for China. The elaboration of the Analytical Framework was supported by Tasks 1.1 to 1.4 and a Co-Design Event organized for all academic, case study and practice partners to compile and structure research questions guiding the further research and work in CLEARING HOUSE. The resulting four work streams listed at the end of this document represent the current state of the Analytical Framework designed in a way that partners of CLEARING HOUSE are assigned to one or more of the streams to continue their work there and to explicitly collaborate with those cases having shown interest in one of the four streams/topics.

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The Analytical Framework is a living document which will be adapted to the ongoing work in the research streams and is thus able to mirror aspirations at the beginning of phase 2 in CLEARING HOUSE with results achieved within the coming 2 years.

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