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

Local co-design workshops synthesis report

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Clearing House - Contract Number: 821242

Project officer: Sofie VANDEWOESTIJNE

Document title	Local co-design workshops synthesis report
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Number of pages	29
Document type	Deliverable
Work Package	WP3
Document number	D3.2
Issued by	EFI
Date of completion	2021-05-19 10:35:44
Dissemination level	Public

Summary

The Sino-European CLEARING HOUSE project aims to provide evidence and tools that facilitate mobilising the full potential of urban forests as nature-based solutions (UF-NBS) for rehabilitating, reconnecting and restoring urban ecosystems. To achieve this goal, the project is establishing a collaborative learning process on UF-NBS and develop a comprehensive co-design and co-learning system to connect policymakers, business, citizens and experts across China and Europe. This document ? deliverable D3.2 ?Local Co-Design Workshops Synthesis Report? - aims at describing the results of the local co-design workshops, including relevant questions for research from stakeholders' perspectives, and suggestions for the analytical framework development. We share the main takeaways of the co-design workshops, and provide analytical inputs that will guide the continuation of the project. The deliverable is structured in three main parts. The first part introduces the objectives and methodology of CLEARING HOUSE co-design workshops. The second part presents the implementation of the co-design workshops, including its main results from both the Chinese and European case studies. The third part draws some comparisons among case studies and identifies key research questions for the future of the project.

Approval

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2021-05-19 11:00:57	Dr. Rik DE VREESE (EFI)
2021-05-19 11:12:24	Dr. Rik DE VREESE (EFI)

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VERSION HISTORY

Version	Date	Author(s)	Partner	Description
V1	13 April 21	Joanne Schanté, Cosima Malandrino	LGI	First Draft
V2	27 April 21	Weicong Fu	FAFU	Second Draft

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EXECUTIVE SUMMARY

The Sino-European CLEARING HOUSE project aims to provide evidence and tools that facilitate mobilising the full potential of urban forests as nature-based solutions (UF-NBS) for rehabilitating, reconnecting and restoring urban ecosystems. To achieve this goal, the project is establishing a collaborative learning process on UF-NBS and develop a comprehensive co-design and co-learning system to connect policymakers, business, citizens and experts across China and Europe. This document – deliverable D3.2 'Local Co-Design Workshops Synthesis Report' - aims at describing the results of the local co-design workshops, including relevant questions for research from stakeholders' perspectives, and suggestions for the analytical framework development. We share the main takeaways of the co-design workshops, and provide analytical inputs that will guide the continuation of the project. The deliverable is structured in three main parts. The first part introduces the objectives and methodology of CLEARING HOUSE co-design workshops. The second part presents the implementation of the co-design workshops, including its main results from both the Chinese (still pending) and European case studies. The third part draws some comparisons among case studies and identifies key research questions for the future of the project.

KEYWORDS

Co-design, co-learning, participation, transdisciplinary, workshops, stakeholder, sustainable urban development, trees, forests, urban regeneration, green infrastructure

ABBREVIATIONS

UF-NBS: Urban forests as nature-based solutions

NbS: Nature-based solutions

KEY DEFINITIONS

- **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.
- **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". (Cohen-Shacham et al., 2016)
- **Urban tree**: usually long living woody organism, usually single stemmed, with the potential to growing at a site in the urban or peri-urban area. This includes roadside trees, trees in squares, parking lots, or in parks and private gardens. Urban trees appear as individual trees, 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.

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1 INTRODUCTION

1.1 Objectives and Structure of the Report

This deliverable describes the results of the local co-design workshops, including relevant questions for research from stakeholders' perspectives, and suggestions for the analytical framework development. The deliverable is structured in three main parts. The first part introduces the objectives and methodology of CLEARING HOUSE co-design workshops and outlines the main information on the occurrence of local co-design workshops both in Europe and in China. The second part presents the implementation of the co-design workshops, including its main results from both the Chinese and European case studies. The third part draws the conclusions, comparing case studies results, and identifies key research questions for the future of the project.

1.2 The Co-Design Methodology

Co-design represents a useful methodology to foster close collaboration with stakeholders and explore the challenges related to the planning, design, establishment and management of UF-NBS. Co-design supports brainstorming on new ideas and collaboratively developing solutions that meet stakeholders' needs. Thanks to their collaborative processes, co-design workshops stimulate collective creative-thinking skills and represent a clear, simple and agile method that ultimately helps to create better solutions for the stakeholders and by the stakeholders.

In CLEARING HOUSE, the co-design workshops were aimed at exploring the state of urban forests as nature-based solutions in the case study cities, and focused on gathering input from participants to co-formulate relevant questions for the research done by CLEARING HOUSE.

The co-design workshops have been organised both in China and Europe in order to bring together city administrations, policymakers, civil society groups and scientists, among others, and contribute to outline the most critical questions to be analysed during the project, further defining the requirements for the tools and actions to be developed by the project. Indeed, beyond agreeing on the importance of setting up participatory processes for policy-making, the CLEARING HOUSE methodology stresses the need to promote the participation and collaboration of a variety of local actors, from all sectors of society. This approach, commonly referred to as the Quintuple Helix approach in the literature (Iaione, 2017), allows for the pooling of resources and knowledge of local actors in order to co-design urban services and infrastructures.

In order to facilitate the organization of the workshops, project partners have provided a Guidance Document ('D3.1 Guidance document for the local co-design and co-learning workshops (including local stakeholder analysis')) to all case study leaders, describing the methodology and recommending the process to follow during the event (see representation below).

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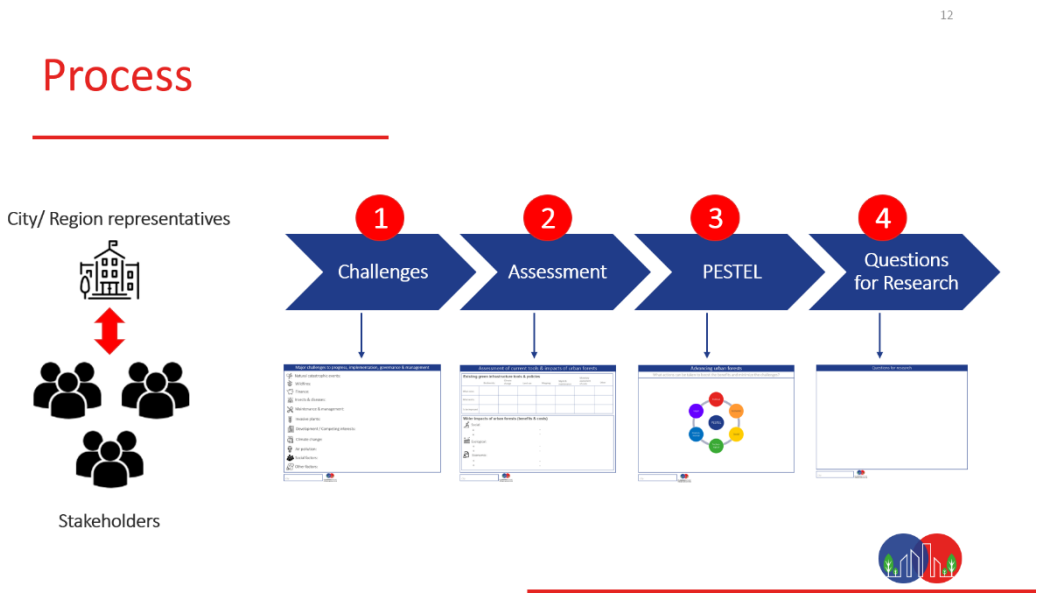

Figure 1 Co-design workshops' process

1.3 European Case Studies

Due to the highly unstable evolution of events and regulations under the COVID19 pandemic, the above methodology had to be adapted to local circumstances. In the case of European case studies, some workshops occurred digitally, thus requiring a more flexible structure, and were split into two or more separate events. The details on the modality of each workshop is listed in the section below.

Table 1: European Case Studies' Workshops

	Objective and target	Format	Date	Participants #
Barcelona Metropolitan Area (AMB)	An initial webinar to raise awareness, the 1st workshop targeting administration (key stakeholders from AMB), and the 2nd workshop targeting research actors.	3 separate events (one online webinar, two in-person workshops - recorded)	22/10/2020 27/11/2020 15/12/2020	Webinar : 180 Workshops : 5 +5
Brussels	A standalone event targeting participants from the government only to discuss ways to strengthen the ecological connectivity and the institutional cooperation in and around the "Sonian City"	1 day event	01/10/2020	18
Gelsenkirchen	A World Café setting exploring the challenges around urban forests through six themes: climate change, recreation, public health, environmental education, ecosystem services and sustainable (urban forest) management. Policymakers, business representatives, citizens and civil society groups took part in the workshop.	4 hours, in person	10/09/2020	46
Leipzig	A workshop to capture common understanding of UF-NBS and reflect on the main challenges related to the status, implementation and future design of UF-NBS. The invitation was extended to	3.5 hours, Digital, hosted by Humboldt-Universität zu Berlin (HUB)	12/11/2020	10

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	persons from the planning authority of the city, local greening initiatives, and environmental scientists.			
Krakow	A lecture followed by a workshop diagnosing the main challenges and key actions for efficient protection of Kraków River Parks, defining main research questions and initiating a process of partnership creation. Representatives of local administration, NGOs, universities and city units were invited.	2.5 hours, in person with possibility of remote consultations	13/10/2020	15

1.4 Chinese Case Studies

Due to the COVID-19 restrictions, it was difficult to organise local co-design meetings in the Chinese cases. The number of people being allowed to convene stayed low until Spring 2021. Chinese stakeholders are not used to working with video-conferencing and/or digital platforms such as Zoom and Mural. Therefore, the Chinese local co-design meetings have been replaced with one workshop during the 2nd International Forest-City Conference (Nanjing + hybrid, 6 April 2021).

Table 2: Chinese Case Studies Workshops

	Objective and target	Format	Date	Participants #
Beijiing	The 1st workshop targeted ecosystem services provided by the new trees, which were planted during the implementation of 2012-2019 Beijing Plain Afforestation project. The workshop discussed the benefits and challenges during the whole cycle of BPAP. Representatives of local administration, experts (ecology, urban/forestry, biodiversity) were invited. The 2nd workshop targeted the main demands and challenges of urban and peri-urban forestry development and management. Representatives of researchers and local officers were involved in the event.	3 hours, in person	8/12/2020 6/4/2021	1st workshop : 6 2nd workshop : 9
Guangzhou-Shenzhen-Xianggang	Two separate workshops were organized during the 2nd international Forest City conference. The main objectives of the workshops were 1) improve the understanding of UF-NBS that were implemented in corresponding cities or region, 2) clarify the main challenges related to the status, implementation and future design of UF-NBS. The local administration and scholars attended the events.	1.5 hours, in person	6/4/2021	9
Hangzhou		1.5 hours, in person	6/4/2021	7
Huaibei	Delayed the workshops due to COVID-19, they will be held in June 2021. Some researchers from another city-Hefei, which is also part of the same province (Anhui) attended the workshop which had been held in Nanjing.			
Xiamen	A workshop to capture common understanding of UF-NBS and reflect on the main challenges related to the status, implementation and future design of UF-NBS. The invitation was extended to persons from the planning authority of the city, local greening initiatives, and environmental scientists.	2 separate online webinar	24/11/2020 27/02/2021	6 10

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2 RESULTS OF THE LOCAL CO-DESIGN WORKSHOPS

We present the results of the local co-design workshops by listing the main takeaways from every case study. For every city, the structure of the results reporting follows the structure below:

1. Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management;
2. Assessment of existing tools & related policies;
3. Wider ecological, social and economic impacts of urban forests (benefits & costs);
4. What actions can be taken to boost the benefits and minimize the challenges of urban forests?

A comparative analysis of these results will be conducted in the third chapter of this report.

2.1 European Case Studies

2.1.1 Metropolitan City of Barcelona

The workshops focused on the Llobregat river area exclusively. Participants tried to fill the existing knowledge gaps in relation to ecosystem services and nature-based solutions, especially those related to urban forests. More specifically, through three particular dynamics, participants of the workshop have debated which ecosystem services are most relevant, which elements are key to enhance biodiversity and ecosystem services in the territory, where they detect knowledge gaps and what is (or should be) the role of trees, parks and forests as nature-based solutions in the metropolitan section of the Llobregat river.

The general narrative reflects on the concept of green infrastructure and on the need to reinforce the ecological connectivity among the different relevant open spaces that have been preserved. The different actors that took part in the workshop agreed that we have forgotten the importance of the river as a blue connector, as we have invested so much in improving the connectivity of other kind of infrastructures, namely services and transport. The Llobregat River ecology system has been cut off. The negative impacts of this action are not only ecological and related to sustainability, but linked to social use and the cultural heritage of the fluvial area. There are the two principal motorways (A-2 and B-23) that have become a huge barrier between the mountains and the river, as well between the old urban centers and the riverbed. This lack of connectivity throughout natural areas undermines the ecological importance of the site and its potential provision of ecosystem services.

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

The major challenges that have been identified in relation to UF-NBS and the CLEARING HOUSE project are:

- More than one administration in charge. Lack of a well-defined governance model.
- The artificialization of the landscape and the river environment.
- The low phreatic level, the quality and the availability to water the vegetation.
- The management challenge posed by exotic species.
- Few patches of riparian forests and coastal pine forests and lack of clear conservation targets
- Agricultural intensification
- Hydric regulation
- Maintaining and enhancing food provision; recover the traditional cultivated tree varieties (Parc agrari)

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The Llobregat River has been transformed throughout history in a sort of artificial waterway rather than a river with a riparian vegetation or a green sustainable environment. The main challenge is how to further preserve the small existing riparian forest pockets and how to trigger new ones. The main goal is to implement a riparian forest that can play a transition role between the more urban environments, located upland, and the riverbed. This is a difficult challenge for many reasons. The actual condition of the river, with an artificial topography due to the construction of motorways and high-speed train lines that alter the relationship with the water table, the strict flooding regulation and the little space available.

Beyond biodiversity, there are also concerns among the metropolitan population in relation to water provision. The amount of water needed from the Llobregat Rivers is going to increase, since the population will be getting less from the Ter River. The major challenge with the river as a blue connector is to ensure its principal functions. Three main factors needed to be taken into account: the river as water source, hydric regulators (connectors, non-flooding systems, reducing storms) and a balanced ecosystem.

Assessment of existing tools & related policies

The only feasible option is to design transitional solutions, allowing the environment to readjust when needed. This implies a sort of constant dialog with the environment, checking how the ecosystem responds and how the desired balance can be achieved. For example, in terms of encouraging natural processes for the recovery of the river, research has been conducted on how to generate meanders in the current trajectory. The main goal of this solution is to mitigate the artificiality of the river space and to improve its water resources.

Wider ecological, social and economic impacts of urban forests (benefits & costs)

When using the map of the workshop, we can see there are a lot of potentialities in the area.

An important task that appears is to value the history of all the areas around the Llobregat River.

Firstly, population around should recognize the area and the riparian forest as an important asset. Without this change of mentality and its value, it will be difficult to encourage the investment of money in repairing the current situation. In this sense, the municipalities with good accessibility are the ones where more opportunities have been detected.

The need for energy production, that has shaped the Llobregat River's surroundings character for example, conditioning it aesthetically, has left many remains that are being abandoned which should be revised. Decisions should be taken on which ones to maintain or what to do with them. In addition, there should be a revision on many streams exits too, especially the ones built with cement and hard materials that canalize them and take their potential as ecosystem services providers out.

The access to some natural spaces around Barcelona is crowded due to the need of physical outdoor activities, exercising, or visiting greener places. The amount of people willing to visit these areas has increased due to the good transport connections and/or the increasing need of outdoors activities. There is a vital requisite in taking this into account and rethinking new approaches to allow for the coexistence between this demand by society and the need to preserve these environment's natural functions and purposes.

On the other hand, agriculture could play a major role as well. If these areas were enhanced, they could accommodate agricultural production too. This is important to increase the appreciation for local consumption. Nowadays, less than 3% of this proximity product is consumed in the Metropolitan Area of Barcelona.

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

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Along the workshop the following correlated actions have been mentioned:

- Ensure connectivity and continuity between the river and other environments.
- Take advantage of the existing streams, mainly canalized, as ecological systems.
- Look for the optimal animal and plants species that would contribute to the process of water regulation.
- Take into account the current and future water restrictions
- Educate the general public in sustainability and sense of place and belonging to the river space in order for them to take care of it, ensure their public financing or their use and access.
- Be extra vigilant about the conservation of species and their importance for our environment.
- Enhance territorial connectivity with forests and trees ("trees as connectors")

2.1.2 City of Brussels

The project proposed to look at the Sonian City, that is, at the relationship between the Sonian forest and the city from the angle of ecological connectivity. This entry point was considered interesting by the participants, who approved it.

Some key Urban Planning questions emerged from the workshops:

Private properties & gardens

- Represent a large amount of the urban green, in some neighbourhoods they are the size of public parks (this is particularly true in the areas under scrutiny);
- Interesting to develop good practices for owners, to let them manage their garden in a 'healthy' way.

Roads & mobility

- Streets and roads were mentioned in different occasions, and are an interesting domain of intervention.
- They represent a source of fragmentation of tree ecosystems, especially -but not only- in the core part of the forest, as well as of soil impermeability. Street lights can also be a problem;
- Many streets, it was observed, are oversized: the drive way is to large, and the side spaces are unnecessary (in those neighbourhood most residences have seemingly enough space in the private terrain). It might be interesting to reflect on where and how reduce the traffic capacity, and increase permeability/tree coverage (a comprehensive approach is required, because otherwise simply freeing streets would lead to increased speed...);

Agricultural areas

- The double nature of agricultural areas: Soil remains permeable, and they offer great potential of afforestation given that they are not built-up. They often represent biodiversity deserts (organic agriculture is only partially addressing this): agroforestry practices should be implemented to change this.

Focus on case area #1 Uccle - St.Genesius-Rode (Western Sonian Forest Area)

The area includes the Waterloose steenweg, a rather green zone, on the west from the forest, which is more residential, and is a the border between two municipalities (the actual demarcation is yet to be determined). It is characterized by very large 'building blocks'; immense spaces, but fully filled with private homes and private gardens.

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

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Private properties & gardens

- Particularly worthy of attention is the questions of fencing. Large plots are often fenced out of a sense of security and privacy and yet, much will be gained if they were opened up to animals, but also to hikers.
- Too many fences are a problem for biodiversity: and here there are issues of culture and of regulation that need to be addressed (it would be sufficient to have them raised of 18 cm)
- Another important question concerns the abatement of trees in private gardens, and the challenges of maintaining them (to preserve biodiversity, but also the character of a neighbourhood. If inventories are rather popular to deal with the issue (possibly bcs they are relatively easy and politically non-controversial) , what matters is actual control that trees are taken down only for a legitimate reasons, and that replanting takes place as regulated.

Assessment of existing tools & related policies

The topic was not addressed in general, if not for one comment regarding Roads & mobility. Brussels Mobility can in any case be an interesting partner, given that they own large portions of land that was initially dedicated to the ring south, but eventually not used for the purpose (need to map this!)

Wider ecological, social and economic impacts of urban forests (benefits & costs)

Water & soil permeability

- Urban forests questions are strictly related to water issues: this is both because of the capacity of trees to store rainwater, and because green areas are permeable to water infiltration.
- The development of waterways can go hand in hand with re-greening the banks and the surrounding and favouring species mobility
- It was noted that the area under scrutiny (the Sonian City) was and is still a relatively green area. This is however changing rather quickly, with second raw development.
- An interesting research question concerns water and where it goes, and how

In the Case area #1

- Vivier d'Oie district in Uccle: still 89% vegetation, so already built-up area or still forest?
- Historical evolution: urbanisation of mainly rural and forest areas, especially rapid but 'unsealed' urbanisation (in district: 12.8 inw/ha), almost entirely residential with lots of green space around it

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

Ecological connectivity

- the question was approached but not fully developed (e.g. need to connect the Natura 2000 sites...)
- Linked to mobility: In neighbourhoods, large profits can already be made when streets are greened, because these can be direct ecological connections (and for water collection, and for neighbourhoods to involve and for biodiversity, and for tree cover, ...)
- Linked to private gardens & questions of fencing: much will be gained if they were opened up to animals, but also to hikers.

The gates to the sonian forest

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- In particular, they can offer the potential for forms of tourism that is beneficial for the city (tourists come to the village, and not only to the parking at the edge of the forest), and for the forest (tourists remain around the gate and do not penetrate too deeply in more reserve-like parts of the forest

Private gardens

- Also: develop, compile and distribute some kind of best practices for garden owners (e.g. suggestions for garden owner: https://www.notrenature.be/votre-nature/diy
- Brussels Persepective already realised a policy note to to help garden owners

2.1.3 City of Gelsenkirchen

Gelsenkirchen - formerly dominated by the coal and steel industry - has been challenged in many ways by the economic and social changes of recent decades. The city is confronted with challenges such as environmental pollution (fine dust and nitrogen oxides), high unemployment rates, massive industrial de-growth as well as by opportunities and difficulties brought about by migration.

At the workshop, the general narrative was relating to five topics :

First, the Ruhr area is densely populated, and it is a challenge - with strong competing usage requirements - to maintain or increase the green and forest areas. In the regional green corridors of the Emscher Landscape Park, many small urban forests, forests and parks are linked together like a mosaic. One of the most important tasks is to expand and secure these network-like structures.

Second, due to the economic situation in the City of Gelsenkirchen, the financial situation is not good and there are budget constraints for the implementation and maintenance of urban forests.

Third, climate change is being felt more drastically, it changes how urban forests look and a lot of uncertainty remains with regards to what can and should be planted for the future.

Fourth, the communication and understanding between different actors in the city can be improved. The same applies to the communication between citizens and foresters. For example, it is not always clear to every actor what term *urban forest* means and who has the responsibility over urban forests in Gelsenkirchen.

Fifth, it became clear that the many positive aspects of urban forests were not sufficiently taken into account. Forest life and nature experience should be integrated into everyday kindergarten and school life or in the curriculum, and other extracurricular learning locations should be established. Urban forests are a key element of health care and are essential for the healthy development of all residents' children. Their immense importance for our physical and mental well-being became evident in the lockdown months.

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

Natural catastrophic events/ climate change

With the advancing climate change and the increasing drought in the soil, the stress conditions for numerous main tree species are increasing continuously. This is intensified by numerous diseases and pests specific to tree species. This creates a high level of uncertainty about climatic developments, including the question of which resilient trees can be planted for the future

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Wildfires

The risk of forest fires increases with increasing heat and drought. However, due to the small-scale structures, the easy accessibility of the forest areas and the increased attention of the residents, this is currently not a serious problem.

Finance

Finances: It was emphasized that the budget for the maintenance / management of urban forests must be increased, because the recreational and welfare services will predominate in the future, the economic return will only be of secondary importance. One suggestion was that photovoltaics could be used on suitable surfaces to finance the management / maintenance of urban forests. Alternatively, climate funds can be used to compensate forest owners for storing carbon in the forest and / or the additional costs of more climate-friendly forest management.

Insects & diseases

Due to the last 3 dry years (2028-2020), the trees in the Ruhr area suffer from the consequences of the drought. In addition, there are further impairments caused by the storms ELA in 2014 (June) and Friederike 2018 (January), the ash dieback, the soot bark disease of the maple, the beech complex disease, the small beech bark beetle and the oak processionary moth, which, due to the conditions favored by the warmth, also the Midsummer shoot of many oaks in 2018 and thus led to a significant loss of vitality of the trees. In addition, the caterpillar hairs of the oak processionary moth contain a toxin that is poisonous for humans and animals and represents a health hazard. The pedunculate oaks in the Gelsenkirchen city area were infested with oak processionary moths across the board in 2019. The fungal spores of the maple soot bark also pose a health risk. Their removal requires considerable financial and human resources

Planning, maintenance & management

Overall, green and blue structures in the city of tomorrow must be linked in terms of content (urban nature) Planning challenges consist of connecting and enlarging forest areas due to the lack of space available. New forests should be planned in the vicinity of existing forests so that they can be linked together. It has also been suggested that green spaces and forests be connected to bodies of water and that small areas may be sufficient. Due to the mining past of the Ruhr area, there are many disturbed soils in urban areas, which is a further challenge. Development of a strategic green planning and close cooperation between the Environment Agency, GELSENDIENSTE (green space maintenance), Lower Nature Conservation Authority, Lower Water Authority, Lower Soil Protection Authority and Forestry Office.

Urbanisation / Development / Competing interests

Competition for space" is a major challenge. Soil is not a reproducible commodity and there are a large number of stakeholders / actors who need space. The annual balances of the use of open space document the progress of land use for residential, commercial and infrastructure facilities. Existing urban forests, be it older trees or more recent forest developments up to approx. 50 years as a result of succession to industrial wasteland, threaten to be sacrificed again and again in the balancing of interests to structural development plans, because the need for housing and commercial settlement and the associated creation of new jobs are prioritized. Also in political bodies. Green island locations in the central metropolitan area are often built over as part of the so-called "densification" and thus

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withdrawn from use for people and nature. The use of open spaces for building purposes creates compensation obligations such as replacement afforestation, for which in turn available (open) areas are desperately sought. On the industrial wastelands that were created, on which natural succession could take place, pioneer forest is finally created. From the point of view of nature conservation, the succession stages upstream of the forest stage are also worthy of protection due to their high biodiversity. This raises the question of which sub-areas could be stopped in succession / development; with which methods and how this can then be financed on a permanent basis. One possibility for increasing the forest area was mentioned as planting trees on cemetery areas that are no longer required.

Social factors

A decisive prerequisite for establishing new UF and maintaining existing UF is the acceptance of the urban forests by the citizens. The general mood is that the forests should be preserved and increased, but not directly on their own property (shading, falling leaves, falling branches). Many different user groups (active people, migrants, old or young people) mean different challenges. For people who have no relation to these natural spaces, forests are sometimes a place of "fear" - how do you deal with it? Another challenge is communication with the public and the acceptance of forest management measures by local residents. It has also been said that forests are areas for the general public and that forests must be accessible.

Other

Governance: With regard to legal aspects, security - "duty to safeguard" is required for existing forests (a large proportion of which are private forests in the Ruhr area). In addition, there are potential fire hazards in urban forests and certain road safety regulations apply, according to which buffer zones are placed between forests and roads. Stricter disciplinary action on rubbish has also been called for. There is a lack of political awareness of ecosystem services and the importance / advantages of urban green.

Assessment of existing tools & related policies

Management & maintenance

- Become active yourself: GEputzt
- Encourage sponsorships - The possibility to take care
- Tree app for city trees. The tree sponsors are not yet sufficiently advertised ("watering sponsors"). At present somewhat over 300 tree sponsors with Gelsendienste.
- Further options in sustainable care: more areas without electricity lines, automatic irrigation and rainwater into the green area.

Biodiversity / Climate change / Land use

- Education for sustainable development (BNE) "Forest as universal learning method"
- „Wasser in der Stadt von morgen“ Initiative for the future to establish a climate-resilient Ruhr region

Wider ecological, social and economic impacts of urban forests (benefits & costs)

Economic

- Effects of accelerated climate change are pests which costs money to rectify the damages.

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- Coniferous trees are more productive for private forest owners
- Expense + income. Focus on ecosystem services, all ES or selected ES?

Ecological

- Urban forests are a habitat for animals and insects.
- Symbiosis of fungi and trees (Mykorrhiza)

Social, mostly related to health benefits – environmental justice

- Sensual positive experiences (smell, coolness)
- Nature observation
- Nature experience, peace and relaxation
- Forests as a meeting place
- Children in the forest: Children looking for peace and relaxation in the forest
- Development of the children is much different for those who visit the forest and for those who do not; Every child belongs in the forest - regularly! (start early)

Public health – Corona

- Corona-induced: outside areas gains in importance
- Corona shows that you need space in front of the front door. What remains of it?

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

- To further engage citizens and strengthen volunteer work
- Raising awareness that "Wild nature is beautiful"
- Promote environmental education and allowing free play in the forest
- Combination of meadow, deciduous and coniferous trees on public areas → Diversity in urban forests; biodiversity is greatest in mixed areas, risk diversification for climate change adaptation
- Provision of recreational facilities in forests: huts, benches. This can also be art installations in the forest.
- More water points (Wasserspender) as this is preferred by marginal groups

Finance

- Proposal: Usage contract model between forest owner and public authorities - why not in Gelsenkirchen? Similar to a contract between Gelsenwasser – Landwirtschaftskammer (LWK). A Cooperation between agriculture authorities and water company to reduce impact on water quality. It seems there is cooperation in different parts of NRW and has been running for a long time.
- Ecopoints (Ökopunkte) different way to assign value but only has conservation benefit

2.1.4 City of Leipzig

The general picture participants drew was a rather pessimistic one in terms of the current state of urban forests in Leipzig. The workshop was opened by a brief introduction into the project and the case study followed by a quick introductory round in which each participant reflected on his or her own perspective on urban forests. Thereby, it was interesting to note the variation between rather

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personal and professional valuations, those assessing the current state and the future state, and those statements which seem to be contradictory between participants.

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

Location factors are becoming less favourable: the situation of trees in Leipzig's parks is highly dependent on the location of the parks, their soil (whether artificially heaped up or naturally grown), and the age of the park. For example, the Lene Voigt Park, as a former wasteland, has a rather young stock of trees, while the Mariannenpark, with natural soil horizons, has old and large trees. In Lene Voigt Park there was a large tree transplantation with plane trees 2000 - 2004, and in 2014 there was a subsequent tree transplantation. However, especially middle-aged and younger trees may not be able to penetrate the compacted soil layers and thus not reach the water reserves in the soil. In addition, the groundwater level also sinks, making it more difficult for certain root areas to reach. A poorly developed root ball is also caused by the long cultivation period of 10 years for the seedlings in the tree nurseries, including several transplantations.

Damage is increasing: Irrigation in particular is problematic because there is an increasing lack of water in the deep soil layers. In particular, locations in the floodplain far from groundwater are at risk, as they were used to a rather high water level and are now unable to adapt. In certain areas, up to 1000 litres of water evaporate every day on hot days. Normally, trees were irrigated three years after planting. Under the current climatic conditions it is currently more likely to be 10 years. Against this background and the current possibilities, it is also questionable whether the old tree population can be saved. Consequently, various types of damage to trees can be identified, ranging from lack of growth, damage to the crown, to drought stress and re-drying.

Tree species distribution is increasingly problematic: It was shown that certain species are particularly susceptible to damage. This is aggravated by the fact that the species are not evenly distributed or distributed according to the location. For example, a tree species tends to be found in road areas with heaped-up or no natural soil horizons. This is partly due to older ordinances and, in the case of avenues, is also protected by monument conservation.

Assessment of existing tools & related policies

Tree production in the nurseries must be improved. This is because, unlike criteria such as root mass, crown or trunk diameter, criteria that harden the trees against heat or drought, for example, are difficult to define and measure. One possibility would be to plant fewer trees per area in the nursery and also to have the entire local cultivation in a regional nursery (e.g. regional nursery Geitheim). However, as this would make the price of the individual tree more expensive, a long-term process of conversion in the allocation processes is also necessary. At present, the awarding of contracts is carried out by landscape construction companies or is decided by the city of Leipzig's city cleaning department with the help of lots within the prize competition (Bund deutscher Baumschulen e.g. Bruns or Lorenz von Ehren).

In the future, the procurement costs must be weighed much more strongly against the expected maintenance costs and proof of origin and quality must be required. It is important that different cities agree on common criteria, so that an alternative purchase of trees without these criteria can be prevented. At present, the purchase of trees is a very long-term process with little flexibility and adaptation to rapidly changing conditions.

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Wider ecological, social and economic impacts of urban forests (benefits & costs)

The engagement and commitment of citizens can be seen, for example, in their willingness to water trees or maintain tree discs. Local initiatives such as the Youth Parliament or "Water the Neighbourhood" play a major role alongside effective public relations work and support the city administration in the care of the tree population and, thus, help to save money. Although this commitment is certainly visible in public space and helps young trees in particular, this cannot be a permanent solution against the background of the challenges described above. Overburdening the citizens is to be avoided just as much as wasting drinking water. Rather, a sense of responsibility and appreciation for trees must be awakened by raising public awareness in order to avoid damage to trees by residents. Appropriate online platforms (also in the sense of where to water and where is damage) can be a simple but effective instrument here.

Not only ecological and climate-relevant aspects should be taken into account in both planting and care, but also water-side limitations of the tree species and location, as well as so-called disservices such as allergies that can be triggered by certain tree species. Furthermore, the degree of care must be balanced. On the one hand, the lowest possible intensity of care allows for a corresponding biodiversity. Old trees, for example, could not be felled directly, but could first be secured with steel cables, crown cuts could be made, or the dead trunk could be left standing. On the other hand, the care of tree populations, especially in urban areas, also goes hand in hand with a responsibility for safety. For example, trees have to be pruned in the course of road safety or certain trees even have to be felled due to lack of safety. No action is taken until it is absolutely necessary, could be the watchword here.

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

Allowing natural succession: Deadwood serves as a habitat for woodpeckers, for example, and also supports the natural regeneration of the tree population. Against this background, it may be necessary to leave part of the park to natural succession in the future. Trees taken from further afield may no longer be an alternative in the future because such species do not adapt to the location. It remains questionable, however, to what extent regional species can adapt to the changed climate conditions. Furthermore, there is a high demand for shade from trees in parks - it is questionable whether succession can be a suitable process, as it is very time-consuming.

Increase diversity: A high number of tree species not only promises greater resistance and resilience to disease, but also offers more potential niches for other species. In particular, the road tree sector should be more diversified. Diversification is also helpful for shade trees in parks, for example, because high trunks are needed where people spend time under trees. Potential tree species for replanting include ornamental oak, field maple (instead of sycamore) and birch. Although old trees die, young trees of the same species can be planted, as the latter can adapt more easily to the site factors. Roads can be diversified in sections, so that tree species alternate at intervals of 50 to 100 metres and the corners and ends of the road are accentuated with other tree species.

Additional small-scale measures: In addition to the diversification of species, including new species, and more intensive irrigation with the help of citizens, other measures will also help. For example, in the case of roadside trees in particular, the tree discs and the rooting space could be increased. Up to a depth of three metres, from which the natural soil is also affected, an optimised substrate could be used, which on the one hand promises good root penetration due to a low substrate density, and on

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the other hand enables a high water retention capacity due to a corresponding pore volume. Coatings, supports and infiltration ditches or irrigation alternatives are further measures.

2.1.5 City of Krakow

The urban forests as nature-based solutions, from participants' description, are an important part of Kraków territory and its spatial planning. The city contains in its borders multiple forests, rivers and landscape parks, which are considered as popular recreational area for the citizens, but also vital for the environment. Those areas are, however, threatened by urban sprawl and new investments, which take green spaces step by step. Because of this, the green areas are not connected and do not create a strong network, which is necessary not only for wildlife, but also for multiple ecosystem services which benefit the citizens.

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

Environment and Climate Change

- Protection of habitats and species
- Long periods of drought
- Conflict of interest (compliance to nature, or nature for humans)
- Damage caused by severe weather
- The river beds are regulated and accessible to citizens
- Lack of definition as a form of nature protection
- River fragmentation (ecological continuity destroyed
- Narrowing of ecological corridors (human-animal conflict)
- Invasive species, especially plants in river valleys
- Water (and parks) pollution
- Buildings and nonpermeable surfaces → investment pressure

Social Aspects and Quality of Life

- Current and new users, lack of full participation in districts' spatial planning
- Various social needs and lack of proper diagnosis
- Conflicts between various users, eg. Noise-silence
- Conflict human-nature
- Investment pressure → nature and citizens (special acts)
- Lack of initiatives to connect city units and ngos
- Rise of spatial development pressure

Economical Aspects and Spatial Planning

- Local spatial planning acts might be opposing
- Numerous administrators (eg. Wody polskie, zzm w krakowie, zdm)
- Often lack of decisions about riverbank development (eg. Drwinka river)
- Lack of open data and maps of continuous public green spaces, parks, foot and bike paths
- Lack of funding for project related initiatives
- Maintenance standards and costs
- Lack of private sector engagement in co-funding, lack of good practices and models

Assessment of existing tools & related policies

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Among existing policies related to UF-NBS in Kraków are:

Spatial and urban planning

- POWIATOWY PROGRAM ZWIĘKSZENIA LESISTOŚCI MIASTA KRAKOWA: (Powiat Programme to Increase Afforestation in the City of Kraków for the years 2018-2040) Strategic document aiming to increase forests area by 8% in the administrative borders of the city;
- KIERUNKI ROZWOJU I ZARZĄDZANIA TERENAMI ZIELENI W KRAKOWIE NA LATA 2017-2030 (Development and Management of Greenery in Kraków, 2017-2030): The document covers various aspects of blue-green infrastructure in the city – spatial planning, land property, cultural heritage, social necessity of green spaces and their accessibility. It also highlights necessary actions in real estate management, spatial planning and cultural heritage management. It also includes the comprehensive GIS data-base (QGIS) with information on natural ecosystems, green-blue infrastructure and many other related layers (~30 GIS maps);
- Miejscowe Plany Zagospodarowania Przestrzennego (Local Plans of Spatial Development), Studium Uwarunkowań I Kierunków Zagospodarowania Przestrzennego (Study of Conditions and Directions of Spatial Development): Those are the main tools of spatial planning used in Poland, they might have a considerable role in development of UF-NBS, they are not however used to do so.

In addition to the above tools ZZM also has competences and various projects related to Urban Forests, River Parks and including the citizens in their planning and realisation. There are also studies and research projects focused on UF-NBS in Kraków, one of them was shortly presented at the beginning of the workshop by prof. Agata Zachariasz from Politechnika Krakowska.

Wider ecological, social and economic impacts of urban forests (benefits & costs)

Benefits

- Various ecosystem services,
- New habitats, migratory corridors and bigger biodiversity,
- Climate change adaptation (eg. reducing urban heat island),
- Reducing a severe weather, floods and droughts damage and impact on the city,
- Citizens activity and social life animation,

Costs

- Lack of private economic costs (conflict between private and public interests),
- Maintenance costs,
- Necessary funding, new law forms and definitions,
- Numerous institutions responsible currently for UF-NBS,
- Necessary maps, analysis and open data about UF-NBS and green areas,

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

- Social participation and including various stakeholders and citizens into the decision making process,
- Initiatives to connect city units and NGOs,
- Using spatial planning tools (such as described in point 2.),
- Blue-green infrastructure and Nature-based solutions investments,
- Policies encouraging and simplifying creation of new green spaces,
- Protection of green spaces from investment and development pressure,

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- Creation of interconnected and continuous system of River Parks, Urban Forests and other green spaces,
- More effective management and additional funding,
- Well communicated benefits and ecosystem services provided by the public green spaces and building a long lasting social awareness.

2.2 Chinese Case Studies

2.2.1 City of Beijing

In the S2 venue of the 2nd World Urban Forestry Conference, Nanjing, China, we held the Co-design workshop. Three participants from the European CLEARING HOUSE project reported on UF-NBS. The organizer gave a brief introduction about the CLEARING HOUSE project and explained how to fill in the questionnaire. A total of 42 participants participated in the workshop. We collected data in the form of filling out questionnaires, collecting relevant data by region, and then discussing it. A total of 42 questionnaires were received, including 6 questionnaires from Beijing, 9 questionnaires from Guangzhou-Hong Kong-Shenzhen area, 7 questionnaires from Hangzhou area, and the other 20 were from Anhui, Nanjing, Shanghai, Heilongjiang, Fuzhou and other cities. We interpreted the questionnaires from Beijing, Guangzhou-Hong Kong-Shenzhen city clusters, and Hangzhou, and interacted with the questionnaire respondents. Almost all participants wanted to express their opinions when discussing the urban forest construction in their respective cities. Therefore, although the entire workshop only lasted an hour and a half, the results of the exchange were fruitful and clear. We can clearly get the focus of different urban participants on urban forests. We also conducted exchanges between the case cities and found that the case cities have some common points of concern and many different points of concern. For example, southern cities pay more attention to extreme natural climates such as typhoons and heavy rainfall. The northern cities are more concerned about air pollution reduction; economically developed cities frequently mentioned that the main cost of urban green space is land value, while other cities mentioned more the maintenance cost of urban forest landscape.

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

The major challenges that have been identified in relation to UF-NBS and the CLEARING HOUSE project are:

- How to use UF-NBS in the process of urban-rural integration
- How to effectively inform the public about the impact of UFBS on ecosystem services (including mitigating the heat island effect, purifying the air, and providing outdoor recreational spaces, etc.)
- As a pioneer in the construction of forestry in the capital and cities, how to build and promote the UF-NBS business model is the main problem we face
- Urban plants, such as poplar fluttering, are allergens of rhinitis
- How to better plan urban forests and make the distribution of urban forests more scientific and reasonable

Assessment of existing tools & related policies

- At present, urban forestry planning and urban green space planning are soliciting public opinions at different stages of the planning. Public participation is relatively high in the construction process, and all interest groups have the opportunity to express their needs.

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- Beijing's one-million-mu afforestation plan has increased the overall forest coverage rate in Beijing and has won the public's approval.
- The construction of the ecological conservation zone has enabled the Beijing area to obtain an ecological barrier, but the problem is that the public's demand for green space in the urban area cannot be met.

Wider ecological, social and economic impacts of urban forests (benefits & costs)

Benefits

- The urban forest improves the air quality in the city, reduces the concentration of pollutants, and reduces sand and dust.
- The urban forest reduces the urban heat island effect and increases the urban air humidity. In particular, the public mentioned that Beijing's afforestation of one million acres is also a case of urban forest construction that has been mentioned many times in the Second Urban Forestry Conference, which has greatly improved Beijing's ecology. The public has clearly felt that the temperature, humidity and the air quality becomes better.
- The construction of urban forests has increased the price of houses, and the price of houses with better urban forests in the vicinity will increase more. This is the content mentioned by some members of the public. By hosting the exchanges with the Beijing public, most of them are willing to pay a higher price to buy houses with better surrounding forest environment in order to improve the quality of life.
- The addition of community parks and pocket parks in the city reduced our travel time to the green space, gained more travel options, and reduced travel time.

Costs

- Some participants believe that too much urban land has been used to make urban forests, so that there is not enough land to build houses and the price of houses rises.
- The construction of urban green space requires urban construction funds.
- The use of urban greening tree species increases our chances of suffering from chronic respiratory diseases.

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

Along the workshop the following correlated actions have been mentioned:

- In the selection of urban greening tree species, try to choose plants without floating flocks, or reduce the floating flocks through technological means to reduce the adverse effects of urban forests on the body.
- In the city center of Beijing, more small urban forests such as pocket parks can be added, so that the public can feel the green space brought by the urban forest in the city center.
- Add some green corridors so that the ecological conservation forest in the outer ring can bring better air into the urban area.

2.2.2 Guangzhou-Shenzhen-Hong Kong City Group

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

- How to control the maintenance cost while improving the urban forest landscape.
- Pests and diseases are huge challenges in the construction of urban forests, especially in the process of planting some tropical tree species.
- The public participation is low, and there is a gap between the construction of urban forests and public needs

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Assessment of existing tools & related policies

- At present, urban forestry planning and urban green space planning are soliciting public opinions at different stages of the planning. Public participation is relatively high in the construction process, and all interest groups have the opportunity to express their needs.
- The construction of urban greenways has achieved great success. The greenways connect the urban forest patches scattered in the middle of the city, so that the public can enter the urban forest faster.
- The promotion of forests into the city and the siege of forests have added urban forests to the city center and obtained ecological barriers around the city.
- The construction of ecological landscape forest has promoted the improvement of the overall urban landscape.
- The construction of forest carbon sinks has improved the effectiveness of forest construction, has played a role in reducing carbon dioxide emissions and slowing down the greenhouse effect.

Wider ecological, social and economic impacts of urban forests (benefits & costs)

Benefits

- The fitness of urban greenways reduces the cost of traveling to the urban forest.
- The construction of the urban forest has brought us a relaxing place and improved the efficiency of work and study.
- The forest siege has brought an ecological barrier to the city.
- The construction of urban forests has improved the image of the city, and green roads have become the business card of Guangdong.

Costs

- Due to pests and diseases, the maintenance cost of urban forests is relatively high.
- The maintenance of some ancient and famous trees costs a lot of money.
- After the typhoon day, it is necessary to spend a relatively large cost to maintain the urban forest.

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

- In the overall planning process, priority should be given to the benefits and impacts that the construction of urban forests will bring to the city, as far as possible to expand the benefits and reduce the impact.
- Try to choose some local tree species to reduce the damage to urban forests caused by pests and diseases.
- Add some green corridors, green slow-moving roads make the public.

2.2.3 City of Hangzhou

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

- How to reduce the concentration of air pollutants more in the construction of urban forestry
- How to improve species diversity and ecological stability in the process of urban forestry construction

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- How to alleviate the conflict between people and land, that is, more land in the city is used to build urban forests. Hangzhou does this, but the roads are more crowded and the housing area for the public has become smaller.
- Control of invasive plants in urban forests
- How to better plan urban forests so that the distribution of urban forests is more scientific and reasonable. For example, the ecology near the West Lake is better, but there are fewer green spaces in the city.

Assessment of existing tools & related policies

- At present, urban forestry planning and urban green space planning are soliciting public opinions at different stages of the planning. Public participation is relatively high in the construction process, and all interest groups have the opportunity to express their needs.
- The construction of the ecological conservation zone has enabled the Hangzhou area to obtain an ecological barrier, but the problem is that the public's demand for green space in the urban area cannot be met.

Wider ecological, social and economic impacts of urban forests (benefits & costs)

Benefits

- Urban forest improves the air quality of the city, reduces the concentration of pollutants, and reduces the dust weather.
- The urban forest reduces the urban heat island effect and increases the urban air humidity.
- The construction of urban forests has increased the price of houses, and the price of houses with better urban forests in the vicinity will increase more.
- The addition of community parks and pocket parks in the city reduced our travel time to the green space, gained more travel options, and reduced travel time.

Cost

- Too many cities have introduced urban forests, so that there is not enough land to build houses and the price of houses rises.
- The construction of urban green space requires urban construction funds.
- The use of urban greening tree species increases our chances of suffering from chronic respiratory diseases.

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

- In the selection of urban green space tree species, try to choose native tree species with strong resistance to diseases and insect pests. Through planting evaluation, select more suitable tree species or scientific mixed planting mode to improve the ability of urban forests to resist diseases and insect pests.
- Promote public participation so that the public can better supervise the construction and management of urban forests.
- Improve the functions of urban forests, such as ecology, landscape, economy and other compound functions.

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2.2.4 City of Xiamen

Regarding the current status of urban forests in Xiamen, the overall impression of the participants is quite optimistic, and they hold an active and open attitude towards urban forestry research. However, due to the online communication method and the unfamiliarity among the participants, the participants seemed restrained at the beginning of the discussion. At the beginning of the seminar, the organizer analyzed the construction of urban green space in Xiamen, and then introduced the future development plan of urban forestry in Xiamen, followed by a brief introduction and case study of the CLEARING HOUSE project. This was followed by each participant's self-introduction and each participant's views on the urban forest in Xiamen. We have observed that after getting acquainted with each other, everyone was willing to share their views on urban forestry.

Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management

- The artificialization of coasts and rivers affects ecology and landscape
- Coastal windbreaks were destroyed during construction
- Extreme weather, especially typhoons, have a greater impact on urban forests
- The maintenance cost of urban forest and urban green space is very high
- How to intensively manage
- How to improve the functionality of urban green space as an infrastructure

Assessment of existing tools & related policies

- At present, the urban forestry planning and urban green space planning will be made public after the first draft of the plan is formed, and the public will receive feedback. It will indeed answer and modify the relevant planning content according to the questions of public concern. This method has been affirmed among all the people involved.
- There is a relatively good complaint mechanism. If there is a problem with the management and construction of urban green space, the public will get a reply as soon as they complain. Everyone believes that this is very efficient and contributes to urban green space construction.
- The management and protection of urban green space is too frequent and intensive, which cannot improve the quality of urban green space, but increases the financial pressure.
- The protection and management measures for ancient and famous trees have improved the protection of ancient and famous trees and made urban construction more historic.

Wider ecological, social and economic impacts of urban forests (benefits & costs)

Benefits

All the public believe that urban forests are an important part of improving urban ecology and urban landscape. The construction of urban green space in Xiamen has a positive impact on the public.

- A place that can bring recreation and leisure to the public
- Improved urban landscape
- Improve the environmental quality of the city, including lowering the temperature, increasing the humidity, and reducing the concentration of air pollutants.
- It has brought economic benefits. The improvement of Xiamen's tourism city and landscape has driven the public to travel to Xiamen, and therefore also promoted Xiamen's service industry and other related industries.

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Costs

The public believes that the cost of building urban green space and the benefits it brings are insignificant, but there are several things that need to be explained.

- The impact of typhoon weather on urban forests, such as falling trees and falling branches will cause danger.
- The construction of urban green space requires urban construction funds.

What actions can be taken to boost the benefits and minimize the challenges of urban forests?

- Inviting more high-level design and construction teams in the process of urban green space planning and construction can improve the level of urban forest construction and urban landscape, and better design can even reduce management and protection costs.
- In the selection of tree species, the use of wind-resistant tree species should be increased to minimize the impact of typhoon on urban forests.
- Building more Tree Top Walks will increase public recreational space without increasing urban land use.
- Add more complaint methods so that the public can better supervise the construction of urban green space.

3 CONCLUSIONS AND RESEARCH QUESTIONS

3.1 European Case Studies – Comparisons

1. **Major challenges relating to the progress and implementation of UF-NBS, and to their governance and management;**

The comparison of the major challenges that arise from the co-design workshops in CLEARING HOUSE reveals interesting commonalities that reflect the important role played by the geographic and spatial planning characteristics of the case studies under study. Indeed, one of the major challenge that is listed by all cities refers to the negative effect that urbanisation and densification processes have on that health and connectivity of UF-NBS. The presence of a variety of users, and thus a variety of often conflicting interests, endangers the resilience of natural resources.

Urban development and competition of space manifests itself as cities prioritise structural development plans that respond to the need for housing and commercial settlement and the associated creation of new jobs. Urbanisation also represents a problem as it constitutes an obstacle to ecological connectivity. The fragmentation of natural spaces is particularly mentioned by Barcelona, where grey infrastructure and transport ways intersect the are of the LLobregat river and therefore undermine the potential provision of ecosystem services. It is also the case if the Sonia forest in Brussels, where agricultural and residential areas as well as road infrastructures act as barriers for connectivity. The untapped potential of private gardens in residential areas is particularly mentioned, due to the fencing and the abatement of trees. The Ruhr are further presents similar issues: the area is densely populated and leads to strong competing usage requirements. The planning challenges consist of connecting existing network-like structures and enlarging forest areas due to the lack of space available. In Krakow, green spaces are threatened by urban sprawl and new investments, and therefore fail to create a strong network, which is necessary not only for wildlife, but also for multiple ecosystem services which benefit the citizens.

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Another major challenge mentioned by the majority of cities is the impact of climate change on the ecosystem of their territory. Growing temperature and extreme events have caused droughts and flooding episodes as well as favored the spread of infectious diseases and insects. In Barcelona, the river ecosystem is threatened by the need for water of the surrounding areas; the trees in the Ruhr area in Gelsenkirchen suffer from the consequences of the drought; long periods of drought are also a threat for natural areas in Krakow; location problems and an increasing lack of water in the deep soil layers is causing damage in Leipzig parks.

Other comparisons can be drawn when it comes to financial resources and administrative problems. The presence of numerous administrative authorities (Krakow and Barcelona), the lack of political awareness of ecosystem services and the importance / advantages of urban green (Gelsenkirchen), and overall budget constraints and lack of funding (Gelsenkirchen and Krakow) represent important challenges for the maintenance and development of UF-NBS in the case studies analysed.

2. **Assessment of existing tools & related policies;**

Fewer comparisons can be drawn related to the existing tools and policies in the different case studies of the project. In Barcelona, the ideal strategy foresees the design of transitional solutions that allow the environment to readjust as the best way forward for the recovery of the river ecosystem. The measures mentioned in Gelsenkirchen instead tend to focus on citizen and stakeholders participation in the maintenance and financing of UF-NBS (become active; encourage sponsorships for trees), and on education for sustainable development. Leipzig participants focus more on the technical aspects related to tree nurseries and tree procurement in order to plant trees that are resistant to drought and heat and to improve procurement practices at the city level. In Krakow finally, spatial and urban planning policies are predominantly mentioned as tools to drive the strategy of the city in terms of UF-NBS. These tools of spatial planning might have a considerable role in development of UF-NBS, but they are seldomly used to do so.

3. **Wider ecological, social and economic impacts of urban forests (benefits & costs);**

Both the Barcelona and Brussels workshops reflect on the importance of balancing the benefits and costs of waterways management in order to both allow for recreational uses and to restore and protect the natural ecosystem. The Llobregat river is indeed an important public space for citizens and it also constitutes a key water, agricultural and forest resource. In terms of its benefits, the citizens need to become aware of the riparian forest as an important asset. Without this change of mentality, it will be difficult to encourage the investment of money in repairing the current situation. When it comes to Brussels, urban forests produce important benefits for water issues: this is both because of the capacity of trees to store rainwater, and because green areas are permeable to water infiltration. It is therefore important to invest in a development of waterways that can go hand in hand with re-greening the banks and the surrounding.

The combination of social, health and ecological benefits of urban forests is also identified by the participants in the Gelsenkirchen, Krakow and Leipzig workshops. Urban forests are beneficial as public health assets in times of coronavirus and they provide natural spaces for citizens to relax and explore. Citizens are often very involved in the maintenance of these places, as it is the case for Leipzig, helping municipalities save money.

From an ecological point of view, these forests are important reservoirs of insects, animals, fungi and biodiversity. They thus contribute to climate adaptation and reduce the risks related to extreme weather events. As for the costs, maintenance represent an issue for many case study cities, and it will

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be increasingly so considering the effects of accelerated climate change that will cause expenditures to rectify the damages.

3.2 European Case Studies – Research Questions

Metropolitan Area of Barcelona

We have identify the following knowledge gaps as research outlook:

- Vegetation/Species that might better adapt to the current conditions of this place and to the ones expected due to climate change. Support with examples and expertise
- The best nature based solutions for each case and situation, and their cost and benefits.
- Climate change scenarios and the consequences related.
- How to better cooperate between the different public administrations and stakeholders
- Relevant governance models
- How to enhance and recover the “cultural memory” of the agricultural landscapes
- Biodiversity data
- Lack of trees and certain vegetation typologies (riparian forests)
- Food provision as a key ecosystem service
- Data on river Llobregat nutrients
- Relevant governance models

City of Brussels

For yet another time during the course of the project, the suggestion was made that 'we already know enough' about the issue. What was reputed interesting, conversely, was to generate 'know-how' on how to approach particular problems.

- It was observed that already a lot of knowledge is available for the area (although it might be interesting to produce coherent mapping bringing together the knowledge from the various regions).
- In this context, a participant indicated how CH should focus on the realisation of concrete tools & on the citizen science part. This was confirmed by a comment from Perspective, indicating that they are really open to new ways to integrate nature in planning instruments (new generation of staff members is aware to this)
- The "gates" to the Sonian Forest represent an area of research and infrastructural development, in terms of understanding and enhancing the city/forest relation.
- Linked to Water & soil permeability: an interesting research question concerns water, where it goes, and how

Three venues of future work can be drawn:

- Contribute to a general vision of city & forest in the Sonian City

The idea there is to contribute to the new structural vision of the Sonian Forest, but by focusing on the 'urban' side of it. It is about the conceptualisation of the Sonian City, and about bringing together actors from different regions talking to each-other.

- Contribute to develop ecological connections in the Uccle - St.Genesius-Rode zone

This is a way to have an 'on-the-ground' counterpart to the previous item, with some implementation. We bring together actors to realize the two ecological corridors proposed during the workshop. We try to reflect on the broader vision (see above) and test it.

- Citizen Science.

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This is potentially interesting. This is mainly perceived as a way to engage citizens, more than as a way to generate new knowledge.

City of Gelsenkirchen

Before implementation an analysis of the current situation is important: mortality rate of trees planted in the last 30 years (dendro analysis) for Gelsenkirchen. Another discussion circled around the question how findings from other regions/locations with other climatic regions can predict for the Ruhr area what can be used for tree planting. This would then influence what species can be planted for the future.

- Regarding public health, discussions focussed on what function of green spaces/forests have in times of crisis like Corona. Could it be possible to investigate the therapeutic effects of forest/ also against pandemics? Where will funds to combat corona go? Into which health philosophies? Corona as a trigger to study the health and forest nexus; Green space to be studied as a priority.
- How long does it take for a behaviour to change? For example, staying in nature areas; Back to nature: Reintegrating nature into life processes
- Can we rate ecosystem services with money? How?
- In maintenance/management, the question was asked whether guiding principles for urban forest are not currently changing? What are guiding principles in other locations (China, Barcelona, etc)? What connects the different principles?

City of Leipzig

Experimental areas for natural succession: Succession is not possible everywhere, for example in parks, as the demand for tall, shady trees does not allow time for it. In order to enable urban forests to develop by succession and thus ensure the survival of certain species, it would be possible to fall back on customary areas. However, the requirements for this are great. Legal conditions such as building regulations, zoning plans, etc. must be taken into account, and conflicts of use between densification and the preservation of open spaces or interim uses must be weighed up. To this end, it is necessary to sensitize tenants and owners, such as cooperatives, to green design and the associated ecosystem services. The city of Leipzig and environmental associations can play a model role in improving the quality of housing and, together with the scientific community, expand the associated advisory services.

Other than that, we detected the following research questions relevant to the Leipzig case:

- What types of trees are particularly affected by heat and droughts and what are tree species with which the ill trees can be replaced?
- What are ways for increasing both the sensitivity of public engagement, as well as responsibility for taking care of trees?
- How do residents perceive the situation of trees and to what extend does this enable new ways of support for the city administration?

City of Krakow

Below are described research questions which emerged during the workshop and a short summary of the organisers. All of the research questions discussed by the groups seem valid and connected to the Cleating House project's aims.

Environment and Climate Change

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- balance between human and nature in the context of preserving continuity → natural or functional?
- what functions might be realised in river parks, concerning continuity, without disturbing the balance?
- discussing the minimal guidelines for investments interfering with river parks (in the city), that is - animal crossings, improving conditions for various species and animal groups
- animal-friendly infrastructure (eg. light pollution, noise, other threats)

Social Aspects and Quality of Life

- how to create protected areas and open the River Parks for the citizens (participation and structure)?
- the possibility of bringing together opening those public areas and effective nature protection? what rules should there be?
- how to influence and create desirable needs and expectations of various groups (citizens, city services etc) concerning the sustainable development of River Parks?

Economical Aspects and Spatial Planning

- River Parks influence on nature monitoring system
- the catalogue of good practices from partner countries → what are their functional effects and economic benefits?
- researching conflict areas (eg. in the historic centre) → where do the conflicts occur and how to act?
- survey of spatial continuity → which method to use? → is there a continuity? → how to survey spatial continuity of the planned investments? satellite data or local visits and research?
- business engagement model → does the business make use of parks functionality and how to engage them? what tools to use?
- how to coordinate river parks policies/management system concerning various stakeholders?
- is the safety of different groups of users (eg. women with children, elders, youths) researched and how?
- how to communicate economic benefits? → how to visualise and encourage? → maps, GIS visualisations presentations
- how to build an effective investment supervision model → how to secure visual identification system from vandalism? signs, boards, landscaping and design, additional patrols?
- how to optimise maintenance costs of river parks exploitation? e.g. amount of street furniture → how to create maintenance standards?

Additional research questions contributed remotely

- Is it justified to prepare local development plans (Miejscowe Plany Zagospodarowania Przestrzennego) or make changes in the existing ones in order to create a uniform city policy for River Parks?

Summary

Important and incredibly up-to-date research questions were named and identified by the participants of Co-Design Workshop in Kraków. However as the organisers, we would like to list also other important issues, which were presented in the first part of the workshop and during discussions. They surely have a potential to be analysed in further CLEARING HOUSE project actions:

- integrated and interdisciplinary river parks management, designing multifunctional public spaces, connecting needs of various users, nature protection standards and ecosystem services vital for sustainable development of the city,

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- assessment and measurement of continuity, various types of continuity (connections between ecological corridors for various plants and animals species; continuity of ecosystem services, continuity of blue-green infrastructure, continuity of potential pedestrian and bike paths etc.), the necessity of searching for and using the multiple methods and types of continuity assessment,
- possibility and rationality of introducing plants (particularly trees and/or bushes) in river valleys.

3.3 Chinese Case Studies – Research Questions

Beijing

We have identified the following knowledge gaps as research outlook:

- Vegetation/tree species that might better adapt to the current conditions of this place and to the ones expected due to climate change. Support with examples and expertise
- The best nature based solutions for each case and situation, and their cost and benefits.
- Climate change scenarios and the consequences related.
- How to better cooperate between the different public administrations and stakeholders
- How to enhance and recover the “cultural memory” of the agricultural landscapes
- Biodiversity data
- Relevant governance models
- How to build and promote the UF-NBS business model

Guangzhou-Shenzhen-Hongkong

We have identified the following knowledge gaps as research outlook:

- Vegetation/tree species that might better adapt to the current conditions of this place and to the ones expected due to climate change. Support with examples and expertise
- The best nature based solutions for each case and situation, and their cost and benefits.
- Climate change scenarios and the consequences related.
- How to better cooperate between the different public administrations and stakeholders
- How to enhance and recover the “cultural memory” of the agricultural landscapes
- Biodiversity data
- Lack of trees and certain vegetation typologies (riparian forests)
- Relevant governance models
- How to control the maintenance cost while improving the urban forest landscape.
- Pests and diseases are huge challenges in the construction of urban forests, especially in the process of planting some tropical tree species.

Hangzhou

We have identified the following knowledge gaps as research outlook:

- Vegetation/Species that might better adapt to the current conditions of this place and to the ones expected due to climate change. Support with examples and expertise
- The best nature based solutions for each case and situation, and their cost and benefits.
- Climate change scenarios and the consequences related.
- How to better cooperate between the different public administrations and stakeholders
- How to enhance and recover the “cultural memory” of the agricultural landscapes
- Biodiversity data

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- Lack of trees and certain vegetation typologies (riparian forests)
- Relevant governance models
- How to build and promote the UF-NBS business model
- How to reduce the concentration of air pollutants in the construction of urban forestry
- How to improve species diversity and ecological stability in the process of urban forestry construction
- How to alleviate the conflict between urban forest and other land used.
- Control of invasive plants in urban forests
- How to better plan urban forests so that the distribution of urban forests is more scientific and reasonable

Xiamen

We have identified the following knowledge gaps as research outlook:

- Vegetation/Species that might better adapt to the current conditions of this place and to the ones expected due to climate change. Support with examples and expertise
- The best nature based solutions for each case and situation, and their cost and benefits.
- Climate change scenarios and the consequences related.
- How to better cooperate between the different public administrations and stakeholders
- Biodiversity data
- Lack of trees and certain vegetation typologies (riparian forests)
- Relevant governance models
- How to change the artificial revetment so that it has more ecological value
- Protection and improvement of coastal windbreaks
- Selection and construction methods of tree species resistant to wind and salinity
- Low maintenance landscape construction
- Improve the ecological value of urban forests

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