Environmental Science and Policy 157 (2024) 103764

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Co-production of urban forests as nature-based solutions: Motivations and lessons-learnt from public officials

Dennis Roitsch [a,b,*], Nicola da Schio [c], Silvija Krajter Ostoić [d], Ivana Zivojinovic [e,f,g], Dijana Vuletic [d], Andrea Armstrong [c], Agata Czaplarska [h], Francesc Baró [c,i], Ian Whitehead [a], Arjen Bujis [b], Rik De Vreese [a]

[a] European Forest Institute, Platz der Vereinten Nationen 7, Bonn 53113, Germany
[b] Forest and Nature Conservation Policy Group, Wageningen University, P.O. box 47, Wageningen 6700 AA, the Netherlands
[c] Vrije Universiteit Brussel (VUB), Geography Department, Pleinlaan 2, Brussel 1050, Belgium
[d] Croatian Forest Research Institute (CFRI), Cvjetno naselje 41, Jastrebarsko 10450, Croatia
[e] Institute of Forest, Environmental and Natural Resource Policy, University of Natural Resources and Life Sciences, Vienna (BOKU), Feistmantelstrasse 4, Vienna 1180, Austria
[f] Forest Policy Research Network of European Forest Institute (EFI), Feistmantelstrasse 4, Vienna 1180, Austria
[g] Center for Bioeconomy, University of Natural Resources and Life Sciences, Vienna (BOKU), Peter-Jordan-Straße 82/II, Vienna 1190, Austria
[h] The Sendzimir Foundation (TSF), Mokotowska 46a, Warsaw 00-543, Poland
[i] Vrije Universiteit Brussel (VUB), Sociology Department, Pleinlaan 2, Brussel 1050, Belgium

ARTICLE INFO

Keywords:
Co-creation
Public participation
Governance
Public administration
Interviews

ABSTRACT

The governance of urban forests as nature-based solutions (UF-NBS) in cities presents numerous challenges for public officials as different socio-cultural, environmental, political, and economic priorities must be bridged. In this context, co-production emerges as a collaborative approach that brings together stakeholders from various sectors to generate new knowledge and address challenges at the intersection of policy, practice, and research. This study aims to investigate the experiences and perspectives of public officials involved in the design, implementation, and governance of co-production for UF-NBS. Based on 22 semi-structured interviews conducted in seven European cities, we show that public officials generally have a positive perception of applying co-production in the context of UF-NBS and express willingness to adopt the approach in the future. Meanwhile, the findings also point to important lessons such as professional facilitation, early participation, participation in networks, institutionalised planning, and the use of platforms for knowledge exchange for successfully exercising UF-NBS co-production.

1. Introduction

There is a growing body of literature that recognises the importance of co-production as an approach to addressing the complex challenges and potential conflicts associated with planning, implementing, and managing urban forests (Basnou et al., 2020; Frantzeskaki et al., 2019; Hölscher et al., 2024). In recent years, there has been an increasing recognition that urban forests are essential for improving the liveability and resilience of cities by providing a plethora of ecosystem services (e.g. local climate regulation, carbon sequestration and mental and physical health) (Gómez-Baggethun et al., 2013; Haase et al., 2014). This growing awareness of the potential of urban forests to provide social and environmental benefits is evident in socio-political efforts to enhance, protect and mainstream them through its consideration as nature-based solutions (NBS) (Cohen-Shacham et al., 2016; European Commission, 2021). Building on natural processes and ecosystems, NBS are considered to improve the sustainability, resilience, and liveability of cities in a cost-effective and efficient manner. Accordingly, urban forests as nature-based solutions (UF-NBS) are 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 (Dumitru and Wendling, 2021). Subsequently, UF-NBS – ranging from street trees, vertical forests to urban parks - are closely tied to efforts aimed at expanding, restoring and maintaining

* Corresponding author at: Forest and Nature Conservation Policy Group, Wageningen University, P.O. box 47, Wageningen 6700 AA, the Netherlands.
E-mail address: dennis.roitsch@wur.nl (D. Roitsch).

https://doi.org/10.1016/j.envsci.2024.103764
Received 1 September 2023; Received in revised form 14 March 2024; Accepted 16 April 2024
Available online 25 April 2024

urban forests (Scheuer et al., 2022), thereby addressing some of the most pressing issues of our time (e.g., climate change, air pollution, biodiversity loss).

To date, planning and managing UF-NBS can be challenging, including understanding and addressing conflicting societal demands and needs, overcoming technical complexities in selecting the right UF-NBS in the right context, ensuring adequate biotic and abiotic conditions, managing disservices and nuisances caused by trees, coping with trade-offs and opportunity costs (Davies et al., 2017; Roman et al., 2020; von Döhren and Haase, 2022). Other planning and management challenges include public budget cuts, difficulties in achieving representation of all relevant stakeholders and overcoming barriers to participation of marginalised groups in decision-making processes (Haaland and van den Bosch, 2015; Hansen et al., 2022). It therefore is important that public officials allow for a culture of learning from different stakeholders by having an open approach to UF-NBS co-production (Frantzeskaki, 2019). Previous research on both NBS (Albert et al., 2021; Bush and Doyon, 2019) and co-production (Chambers et al., 2022; Hölscher et al., 2024) has shown that bringing together different stakeholders and diverging knowledge through co-production is a promising approach for dealing with complex challenges and potential conflicts related to NBS interventions.

Co-production is commonly defined as a process of consensus-based decision-making and knowledge creation involving multiple stakeholders, with the aim to address complex sustainability challenges, deliver services and develop policies (Bremer and Meisch, 2017; Wyborn et al., 2019). Stakeholders, from government agencies, academia, the private sector, and local communities, join hands and share information, capacities, resources, and decision-making to achieve an objective that would not be realized if they worked in isolation. This implies shifting away from a single actor approach, and consequently, being collaborative and open to other sectors and disciplines (Norström et al., 2020). In addition to the term co-production, a variety of terminologies are used to describe collaborative decision-making processes. These terms often overlap or intersect with co-production and are sometimes used interchangeably in different contexts by different institutions. Although with different nuances, examples include co-creation (Ansell and Torfing, 2021), co-design (Basnou et al., 2020), collaborative governance (Emerson et al., 2012; Malekpour et al., 2021), participatory governance (van der Jagt et al., 2016), mosaic governance (Buijs et al., 2019), partnerships (Whitehead et al., 2017), and adaptive co-management (van der Jagt et al., 2019). Given its proximity with cognate concepts, this study takes a broad perspective to illustrate the different approaches that emerge from the literature. Hence, "co-production" is for our purpose used as an umbrella term covering the wide range of collaborative decision-making approaches at the nexus of policy, practice, and research.

Co-production is a widely used approach in sustainability research and has found application in a wide variety of decision-making contexts, including urban planning, public health, science and technology studies, international cooperation, and urban forestry and greening (Miller and Wyborn, 2020; Satorras et al., 2020). Co-production refers to the ideal of being sensitive to and responding on the needs and priorities of local communities and other stakeholders to create mutually beneficial outcomes (products and services) that are more efficient, effective, and sustainable then more traditional approaches (Wyborn et al., 2019). Possible benefits include a better understanding of sustainability issues, broader social networks, more democratic problem solving, bridging potential trade-offs and facilitate contrasting views between stakeholders (Lemos et al., 2018). To achieve sustainability goals, the co-production of UF-NBS should be based on the inclusive, systematic, and active involvement of various stakeholders and citizens through multiple platforms (Kiss et al., 2022; Reed et al., 2018). Others have pointed to the potential of co-production in giving those most affected by environmental and urban planning decisions not only a voice, but also the opportunity to actively participate in shaping beneficial outcomes (Buijs et al., 2024; Verschuere et al., 2012). In particular, by including local needs and priorities, the notion is that UF-NBS interventions are to be more relevant, accepted and supported by the community (Djenontin and Meadow, 2018), potentially leading to a more equitable distribution of its benefits across society. Evidence suggests that co-production of UF-NBS can also free access to external (new) funding streams not available to statutory authorities and develop untapped capacity within the community to manage and develop interventions (Trencher et al., 2014).

Available literature shows that co-production has its challenges, and it should be recognised that it is not a panacea, nor should it be seen as uncritically positive (Lemos et al., 2018; Norström et al., 2020; Wyborn et al., 2019). Co-production (often) fails to overcome social inequalities (Musch and von Streit, 2020; Toxopeus et al., 2020), can be consumed by power dynamics (Turnhout et al., 2020), or fails to achieve the goals set out to address (Polk, 2015). For example, Kiss et al. (2022) find that higher levels of citizen participation in NBS do not necessarily enhance ecological sustainability outcomes, although social objectives are often realised. Based on 58 NBS case studies in 21 cities, Kiss et al. (2022) show that only when deeper participation (citizens in control or given more power) is achieved, opportunities for social learning, environmental stewardship, inclusivity, and equity are realised. Van der Jagt et al. (2016) claim that these processes do not necessarily present an empowerment of civil society, but that the delegation of some aspects of urban forest management from governmental to non-governmental stakeholders takes place against a backdrop of shrinking public budgets for urban forests due to austerity measures and neoliberal principles (Konijnendijk van den Bosch, 2014). Moreover, questions have been raised about the effectiveness and outcomes of co-production as it can easily become time, staff, and financially intensive (Basta et al., 2021).

Overall, these studies show that co-production may provide many social, environmental and justice benefits, but is also met with criticism and several remaining challenges. This paper engages with the potential benefits and challenges from the views of public officials. While the majority of research on potential benefits and challenges has focussed on single cases, this paper analyses experiences from several UF-NBS co-production processes across Europe. Moreover, while insights from many different actors are well-documented (Basta et al., 2021; Boothroyd et al., 2017; Kiss et al., 2022), the views of public officials remain underexplored (Hansen et al., 2022; Hölscher et al., 2024).

A better understanding of the motivations, benefits, and challenges of public officials in entering UF-NBS co-production seems critical as co-production has gained prominence in urban forest governance (Ansell and Torfing, 2021; Voorberg et al., 2015) and as public officials frequently function as initiators, stewards, and implementers of the entire process (Zingraff-Hamed et al., 2020). Much of the success or failure of UF-NBS co-production depends on their motivations, the benefits they derive from the process, the challenges they encounter, and the outcomes derived (Basnou et al., 2020; Sorrentino et al., 2018). Therefore, we set out to explore and describe their motivations, their experiences, and their views of the benefits, challenges, and lessons learned. More specifically, this research focuses on four research questions: i) what motivates public officials to adopt co-production approaches, ii) what are enabling and impeding factors in UF-NBS co-production, iii) what are the perceived advantages and disadvantages of UF-NBS co-production, and iv) what lessons have public officials learnt from navigating UF-NBS co-production.

2. Methodology

2.1. Case selection, data collection and data processing

This paper draws on 22 interviews with public officials from seven European cities and urban regions to investigate their experience with UF-NBS co-production. Between March and July 2022, the interviews were carried out with selected public officials in Brussels (Belgium),

Gelsenkirchen (Germany), Krakow (Poland), Essen (Germany), Sarajevo (Bosnia and Herzegovina), Wroclaw (Poland) and Zagreb (Croatia). Starting from the city network in the EU H2020 CLEARINGHOUSE project (Brussels, Gelsenkirchen, Krakow), four cities were added to span different regions of Europe (from West to South-East). Their varied ecological, cultural, and socio-economic background is representative of cities across Europe, e.g. Essen and Gelsenkirchen are twin-cities transiting away from their old industrial heritage (particularly coal and steel), while Brussels, Krakow, Sarajevo, and Zagreb represent the cultural-historical centres of their respective regions and countries. Furthermore, Krakow, Wroclaw, Zagreb, and Sarajevo are former socialist countries and are post-transition economies today. The sample includes smaller cities (e.g., Gelsenkirchen) to larger city regions (e.g., Brussels Metropolitan Region). The political and planning contexts also differs from one of the founding EU countries (Belgium, Brussels) to recent EU member states (Croatia, Zagreb) to an EU candidate country (Bosnia Herzegovina, Sarajevo).

We selected interviewees based on two criteria. First, the interviewees needed to work in urban forestry, urban greening, NBS, or closely related fields. Second, they needed to have experience with interventions and initiatives applying a co-production approach. Interviewees represent various levels of professional experience and seniority (See Appendix B). To ensure the sample comprised similar types of public officials across different cities, interviewees were requested to provide further contacts who met the specified criteria, utilizing a snowball sampling approach at the conclusion of each interview.

The semi-structured interview guide is organized into five sections containing questions on the i) experiences of the respondent with co-production, ii) initializing intervention phase, iii) implementation phase, iv) outcomes, and finally v) outlook for co-production (See Appendix A). The design of the interview guide was an iterative process between the authors of this study. Colleagues outside the author team reviewed the interview questions for clarity. Next, the questionnaire was tested in the field, but there was no additional need to revise questions before translating the questionnaire into the local languages (Croatian, French, German and Polish) in which the interviews were conducted. All interviews were conducted by authors to this paper, who are aware of the local contexts and who are native speakers to the case (interviews in Sarajevo were conducted in Croatian, which is very similar to Bosnian). Consistency between interviews was guaranteed by strictly following the interview guide.

During the interviews, the interviewees were asked to focus on specific co-production interventions with which they have experiences and to answer in the context of what happened during those interventions. The interviewees reported on UF-NBS interventions that vary in urban contexts (location and size) and time frame. Table 1 gives an overview of the UF-NBS interventions in this study.

All interviews were recorded (average duration 50 minutes) with the consent of the interviewees and transcribed into local languages using QSR International Nvivo online transcription software and translated by online translation software. Afterwards, the respective interviewer (native speaker) checked the quality of transcription and translation to ensure that there were no linguistic misunderstandings. The English transcripts were qualitatively analysed using MAXQDA 2022, a computer-assisted qualitative data analysis software, by the native interviewers, to guarantee a correct interpretation (in line with the cultural context).

2.2. Analytical approach

The analysis applied a concept driven approach (deductive category formation) by first coding the transcripts to structure and identify relevant text passages based on the interview guide's logic (Kuckartz and Rädiker, 2019). After multiple meetings between the analysing researchers to ensure a common understanding and interpretation of the

Table 1
Overview of co-produced UF-NBS interventions that were referred to by interviewees.

City (label)	Intervention	Description of intervention	Timeline
Kraków	Drwinka River Park	Protection actions of wild river park by the municipality and Municipal Green space Authority in Kraków attributed to residents' pressure.	Since 2014
	Krakovian Parks Project	Citizen's planting trees to symbolise their newly born children.	Since 2017
Wrocław	Come and plant a tree	Tree planting actions during family picnics (in connection with Grow into Wrocław project)	2014–2016
	Grow into Wrocław	Biannual tree planting actions by residents as a symbol of their children born in Wrocław. Includes many attractions for children e.g., DIY workshops, bouncy castles and competitions.	Since 2017
Sarajevo	Connecting Nature – The Sarajevo Process	Engaging residents with a co-creative arts-based approach to learn about NBS/nature.	2017–2022
Zagreb	Interreg URBforDAN Project	Creating an operational plan and integrated forest management plan by engaging different users of the same area, incorporating their wishes and solving conflicts.	2018–2021
	Productive Green Infrastructure in Industrial Areas (proGIreg)	Defining brownfield sites, accelerating and encouraging local governments to transform these areas based on an innovative approach to NBS.	2018–2023
Gelsenkirchen/ Ruhr area	Industrial Forest Project	Green inner-city development through natural succession on post-mining areas. Promoting green forest wilderness within the cities of the Ruhr area is.	Since 1989
	PlanBirke plus C	Citizen science research on birch trees in the context of climate change, biodiversity, and water retention.	Since 2022
	City of the future: healthy and sustainable metropolises	Focusing on the benefits of green-blue infrastructure in the city of the future.	2012–2016
	Future city 2030+	Exploring what the city of tomorrow should look like by applying educational approaches and participation processes in neighbourhoods on the example of four real laboratories.	Since 2018
	Photo competition "Industrial Forests"	Visual interpretation by citizens of what they understand by term "industrial forest".	2016

(*continued on next page*)

Table 1 (*continued*)

City (label)	Intervention	Description of intervention	Timeline
Essen	BaumAdapt	Investigating how to protect forests in the city as critical infrastructure after climate change disturbance events by bringing together all stakeholders.	2018–2022
	Full water can	Watering trees in the city with support from the local population.	Since 2020
Brussels	Plans for Environmental Transition and Life	Improvement of the governance and methods of revegetation and maintenance of trees.	various
	Parc de la Rosée	The development of a small neighbourhood park from abandoned land to a green park.	Since 1995
	Saule project	Co-create intervention for the development of an urban agriculture project involving the local community.	2017–2020
	Parckfarm	Developing a model park including extensive planning with meadows, vegetation, and trees native to the area. After the Parc design festival (international public space architecture and art competition) in 2014, some exhibited projects stayed on and are now managed together with the local community.	2014
	Brussels Ecological Network	Strengthening nature as part of the Nature Plan in Brussels by collecting feedback from local stakeholders.	2012

data, in a second round of coding, the researchers extracted the most relevant arguments, quotes, and stories relevant to the research questions. During the coding process, the focus was on themes that were particularly salient in the data, specifically on the respondents' relationship to co-production, why respondents chose to co-produce or not, and what was learned that would be useful for future interventions. The next step brought all coded summaries together and the research team removed any redundancies. In a final step, based on how the interviewees identified, mentioned, and discussed various aspects related to enabling and impeding factors, as well as advantages and disadvantages, the researchers summarised and formulated comprehensive statements about what the interviewees had learned throughout the UF-NBS co-production process. This inductive approach of summarising was particularly helpful in distilling the key insights from the interviews.

3. Results

Here, to protect anonymity of the interviewees, the themes and quotations are labelled with a neutral ID reference. The ID references behind each theme indicate the number of interviewees who identified a particular theme. An overview of the frequency all themes can be found in Appendix C.

First, we report who is typically the initiator of UF-NBS co-production. In the experience of the interviewees, co-produced UF-NBS interventions are typically initiated and shaped by public officials or other institutional partners (e.g., universities), with the involvement of the local community (i.e., locally residing non-experts taking part in the UF-NBS intervention) occurring later. Most stakeholders are brought in as partners and sometimes as sponsors: *"I have always insisted on – and it's something we're still doing – signing agreements and striking up partnerships with these administrations."* (ID19). The importance to not only identify key stakeholders but to involve them from the start was deemed important by most respondents. An interviewee explains: *"Maybe we should have involved them more from the start, so that they might have gotten a little more involved as a result."* (ID1).

3.1. Motivations for co-production in UF-NBS interventions

Motivations for adopting a co-production approach in the context of UF-NBS include that public officials are interested in *meeting the wishes and demands of residents* (ID3, ID11, ID13) as far as possible, considering budgets and feasibility. Furthermore, it became clear that *filling knowledge and expertise gaps, including local specialist/expert knowledge* (ID1, ID20) is similarly important. Other motivations related to *building awareness* (ID7), *gathering public support* (ID4) for UF-NBS interventions, and to get *inspiration and ideas from other cities* (ID7). Likewise, the hope for meaningful outcomes played a role in the motivation, both through the involvement of scientific partners and through collaboration with other stakeholders who would bring new perspectives and thus contribute to *developing innovative solutions* (ID2; ID13). Also, previous *(positive) experience with co-production* (ID4) was one of the motivations to opt for such a process. Lastly, *gaining legitimacy* (ID20), anchoring and recognition of one's own actions (those of the institution) within civil society were also named.

3.2. The enabling and impeding factors to managing UF-NBS co-production over time

3.2.1. The enabling factors to UF-NBS co-production

Over time, co-production is influenced by various enabling factors. While *sharing, recognising, and drawing upon different knowledge and expertise* (ID6, ID2, ID4, ID20) was considered an important factor, another crucial element was a *coordinator* (ID1, ID5, ID18) who has a multifunctional role as a person who ensures information sharing, access to data, motivation, and inclusivity. Furthermore, it was considered important to *effectively manage the different expectations* (ID2, ID18) of the other partners, to have a *clear time limitation* (ID1, ID2), and to have a *mentality of perseverance* (ID2, ID18) in the face of the complexity associated with co-production. Interviewees indicated that a short intervention is easier to manage in terms of keeping people motivated and empowering them to shape it (ID2, ID5). *Using digital technologies* (ID2, ID5) such as social media and apps can help to engage citizens and make their voices heard. Also, *creating events and activities for all generations* (ID18, ID7) that combine food, nature, and family with opportunities to take and share photos was also mentioned. In addition, it is important to be *flexible and adaptable* (ID18); to integrate *mutual benefits for all stakeholders* (ID2), and to have the ability to *delegate* (ID19) responsibilities. To ensure a smooth process, communication was vital. This means to be aware *of language and avoiding the use of technical jargon* (ID1). Another factor that helped to the smooth running of co-production is *creating a sense of ownership and responsibility* (ID7), such as planting a tree and having a name plaque with it. Given the temporal nature of trees and forests, this *created a sense of future importance* (ID7) i.e., to plant for future generations so that current generations "*come back to look at [it] together with the child*" (ID7). Another noted that the *scale of the project* (ID1) matters and argued that more citizens can be actively involved when the funding is spread over several smaller projects. This allowed citizens to choose their own areas of interest, making it more manageable for them. Ownership of land and urban forests is another consideration when co-producing, as it is possible that *public/private boundaries can be blurred* (ID2) during the process. For example, if forest

owners like the idea of the UF-NBS intervention, they may be more willing to lease the forest or green space for a limited time or even an indefinite period. Other key factors in UF-NBS co-production were *raising civic awareness* (ID7); conducting *education through action* (ID7) to involve skills in education, training, and public engagement. Finally, demonstrating evidence on the *positive cost-benefit analysis of (UF-NBS) co-production* (ID18).

3.2.2. The impeding factors to UF-NBS co-production

Frequently mentioned impeding factors included *time constraints*, *constant pressure and/or dealing with competing pressures* (ID18, ID19, ID1, ID2) and generally *dealing with complexity* of how UF-NBS co-production is designed (leading to a feeling of being overwhelmed by stakeholders and project coordinators alike) (ID19, ID20, ID2). *Tokenistic* consultation was mentioned, highlighting the *challenge of representation* (ID20, ID1, ID7) when selecting partners. Issues related to *power imbalances* between stakeholders (ID20, ID21) was a common concern in UF-NBS co-production, where powerful voices may appropriate the intervention for their own goals, excluding others. Conflicts related to *different and competing values of nature* (ID18, ID19, ID6) and *competing or contradicting views of co-production* (ID18, ID20) contribute to resistance in participation in UF-NBS co-production. For instance, in one UF-NBS intervention, *co-creation became political* (ID20) because it was used to support certain political positions and that contributed to some stakeholders being *"silenced somewhat and restricted"* in the process. The *seasonal pressure* (ID2) of tree planting is also noted. Communication emerges as a noteworthy challenge, encompassing the use of *technical language and jargon*; *poor communication between stakeholders* (ID1) and a *lack of consultation* (ID18) with other partners or potential partners. *Low levels of civic participation* (ID7) are attributed to societal norms and *"a relatively low sense of responsibility for the common good"* (ID7). Then again, *different work cultures* (ID20) created a challenge like *"different attitudes to the site – physical and symbolic"*, while some feel personally connected, others feel separated. *Constraints* were seen at the *citizen/community* (ID7) scale whereby they *"may have ideas but were unable to realise them due to not understanding the full implications e.g., funding, tree planting and especially the selection of species and designing the space for nature"*. Inclusion and exclusion issues arose from the divisive nature of *digital technologies* (i.e., messenger apps, social media) in terms of political divisions (promoting hate and rude discourses; ID7) or generational gaps (older vs younger participants; ID1).

3.3. Perceived advantages and disadvantages of UF-NBS co-production

3.3.1. Perceived advantages of UF-NBS co-production

Interviewees generally acknowledged the multiple advantages of engaging in UF-NBS co-production. Aspects that resonated with interviewees was the importance of co-production for *networking and collaboration* (ID17, ID20, ID13, ID15) and for *reaching common goals* (ID21, ID22, ID5). Another advantage was that it facilitates the exchange of *knowledge, perspectives, and skills* (ID2, ID6, ID9), which enhanced overall coordination, cooperation, and long-term commitments. Co-production made it easier to meet diverse demands and align them with municipal management or planning authorities. This promising and potentially successful co-production brought together *diverse actors* (ID19, ID9) from government, academia, and the public, creating a communication platform. More specifically, to *embrace an audience through real participation* (ID10), and as one interviewee agreed: *"This is not an alternative to public participation, but real public participation."* (ID3). UF-NBS co-production promoted a *learning process* (ID2, ID5), which can lead to a *better understanding among those involved* (ID1) and the *possibility to raise awareness* (ID1) for UF-NBS topics generally. Ideally, UF-NBS co-production promotes *social cohesion* (ID21) and *makes a project well received, with less conflict* (ID6). It has the potential to *level out extreme opinions* (ID4) and thorough planning and organisation ensures outcomes of *local relevance* (ID3), *creating a sense of ownership among users of a green space that leads to less vandalism* (ID18) and more support for co-production, while also *spurring the motivation and enthusiasm* (ID17) of all stakeholders involved.

3.3.2. Disadvantages of UF-NBS co-production

This study also identified several disadvantages and challenges associated with implementing UF-NBS co-production. One key issue was that respondents perceived it as (highly) *time-consuming* (ID3, ID6, ID8, ID17, ID19, ID21) and hard to sustain over an extended period. That co-production can ignite *group dynamics, including contradictory interests* (ID4, ID11, ID16, ID17) was also frequently reported.

Keeping the interested parties actively engaged in co-production proved particularly challenging, especially when the process did *not produce desired change* (ID20, ID21, ID22, ID8). Public authorities must balance their regular responsibilities while addressing various demands and evolving needs, which can change depending on interests of stakeholders.

Furthermore, UF-NBS co-production often faced constraints due to *insufficient staff and financial resources* (ID5, ID17, ID22) since funding is typically time-limited (needed to organize a "good" co-production). Consequently, ensuring the longevity of UF-NBS co-production after funding ends, or when the goals are short-sighted and solely intervention-focused, becomes a challenge. This challenge affects both managing/planning authorities and citizens alike. In several cases, UF-NBS co-production became an additional task for public officials, making it difficult to manage alongside their existing responsibilities. There was a recognition of the need to involve an external expert organization that can facilitate and mediate co-production, acting as an intermediary between the initiating administration and the involved partners. Consequently, a *lack of facilitation* (ID5, ID6, ID16) is considered detrimental to co-production.

Communication issues (ID6, ID17) and *biased participants* (ID6, ID17) were part of the reason why interviewees considered it *challenging to involve people* (ID9, ID10). Another notable risk was the need for proper execution so that co-production is effective, as an interviewee succinctly put it: "*If you don't do it right, then it doesn't really happen.*" (ID18). In some cases, co-production was undertaken merely for the sake of doing it, and not for the right reasons: *"[…] we often start up participation processes for the sake of a clear conscience, as I see it. We do it because it is "hip" (trendy), it is fashionable and so, we are just going to consult a few people, invite them to five workshops in the evening, and call that participation. […] It is not participation, it is consultation, sharing of information, call it whatever you want. It is not participation."* (ID18).

Moreover, if UF-NBS co-production failed to yield tangible changes or meet expectations, it becames difficult to justify or perceive its success. This led to *loss of trust* (ID10) in the process and its potential. Another issue arose when the topics addressed in co-production were overly complex, as one interviewee put it: *"It is very complex"* and *"we humans like things to be simple."* (ID2).

However, one interviewee perceived no downsides to co-production: *"I don't want to list any disadvantages because I don't think there are any disadvantages, because we get to talk to people and that outweighs everything else. So, I really do not see any disadvantages."* (ID1).

3.4. Lessons learnt from UF-NBS co-production

This section presents lessons learnt from UF-NBS co-production, based on a comprehensive summary of their views on enabling and impeding factors, as well as the advantages and disadvantages mentioned.

Overall, five important themes were systematized from the interviews as essential for navigating UF-NBS co-production (see Table 2). These themes relate to the ensuring skilled facilitation, the involvement of a (diverse) range of actors (forestry experts, moderators, leaders, local community, NGOs, and media) at an early stage, the participation in networks (make use of networking mechanism/tools), the adoption of a

Table 2
Lessons learned from UF-NBS co-production.

Facilitation	Organise skilled facilitation. Professional facilitation (e.g., trained staff).
Participation	Early participation of all actors. Involve different actors (experts, coordinators, local community, volunteers, public organisations, non-governmental organisations and the media). Identify and involve leaders in the local community.
Networking	Participate in or create networks.
Planning	Long-term adequate funding. Long-term availability of resources (time, staff, and materials).
Knowledge and information	Use different UF-NBS platforms and means. Mix different types of knowledge. Organize trainings/knowledge exchange for local communities and other involved actors.

long-term planning approach that extends beyond the UF-NBS interventiońs duration, including for resources (e.g., financing for the UF-NBS intervention), and the organisation of training sessions for knowledge exchange for local communities and other actors (mix several types of knowledge).

4. Discussion

This study aimed to investigate the motivations, benefits, and challenges, and lesson learnt by public officials engaged in the co-production of UF-NBS.

4.1. Motivations influencing UF-NBS co-production

Our analysis shows that motivations behind the adoption of co-production for UF-NBS are multifaceted and complex. In the context of nature management, previous studies categorise motivations as normative, instrumental and substantive (Kamphorst et al., 2017; Rauschmayer et al., 2009; Young et al., 2013). Our respondents especially mentioned instrumental motivations for choosing co-production, related to e.g rational and efficient goal attainment, growing trust and dispute reduction between stakeholders (Kamphorst et al., 2017; Young et al., 2013). Also substantive motivations - improving decisions by incorporating stakeholders' knowledge and values into the process (Kamphorst et al., 2017) - are important drivers for co-production. In contrast to existing literature (Ibid.), co-production processes in our cities seem not to be driven by normative motivations. Personal values and supporting democratic processes are not stated as reasons for implementing co-production in our study. Instrumental benefits of co-production are the most important motivations for most practitioners. One important instrumental motivation is building and raising awareness around the benefits of urban forests and trees, especially among policymakers. It can be attributed to the fact that most interviewees represent municipal authorities responsible for urban nature conservation and forestry. The funding of these departments, particularly in times of austerity, competes with other public administrations and private interests (Kiss et al., 2022). As co-production provides the opportunity to engage directly with politicians, the public and other decision-makers (e.g., at tree planting campaigns), the process represents a promising way to illustrate that, for example, investments in urban green space can contribute to significant cost savings due to the reduction of energy consumption in buildings, elimination of pollutants, and carbon sequestration (Haase et al., 2014; Turner-Skoff and Cavender, 2019). This aligns with previous studies where co-production contributed to raising awareness among policymakers and the local community, for example by making these topics more tangible (Boezeman, 2016).

Another crucial instrumental motivation among the public officials is to gain legitimacy and public support for UF-NBS-related management and policy decisions. This motivation may stem from contextual factors, such as a (perceived) increase in tree mortality due to climate change, as well as an (perceived) rise in extreme disturbance events like droughts, bark beetle infections, and wildfires. These factors have led to heightened public concern and conflicting viewpoints in the forest sector regarding the appropriate adaptation of forest management in recent years (Roitsch et al., 2023). Consequently, it has become increasingly important to strengthen the legitimacy of those responsible for overseeing these ecosystems (Lebel et al., 2015; van Kerkhoff and Lebel, 2015). Co-production is also a means of strengthening the legitimacy of the development of UF-NBS solutions per se.

While these instrumental motivations are well-described in literature, we also identified relevant instrumental motivations not yet described in literature. These include the development of innovative solutions and the desire to get inspiration from other cities. This aligns with existing literature on co-production in other domains, which suggests that humans, as benefit maximisers, commonly opt for co-production when they feel that the benefits exceed the costs (Verschuere et al., 2012). Similarly, the inclination to discover (innovative) solutions that were not previously considered (e.g., green roofs) and the recognition that lessons can be learned from the experiences of other cities, are inherent to the concept of co-production in the joint development of (new) knowledge (Cash et al., 2006; Miller and Wyborn, 2020). These results highlight the importance of platforms for knowledge exchange and best practices such as Nature-based Solutions Initiative (naturebasedsolutionsinitiative.org), Urban Nature Atlas (una.city), and OPPLA (oppla.eu).

Next to instrumental, also substantive motivations, drive co-production processes. We identified two key substantive motivations: Filling knowledge and expertise gaps and achieving relevant results, including the co-management of UF-NBS. The desire to filling knowledge gaps and drawing on others' expertise has also been shown as a strong motivation for engaging in networking as part of urban governance in the US (Bixler et al., 2020). The mentioned outputs (or results), such as the development of a city district strategy, and outcomes such as raising awareness, especially among politicians, align with earlier studies that emphasise the diversity of potential outcomes of co-production processes (Chambers et al., 2021).

4.2. Lessons learnt and policy recommendations for UF-NBS co-production

This study identified several lessons and recommendations that may help public officials and policymakers to navigate UF-NBS co-production and ensure its long-term viability. These elements can be categorised at the (inter) personal and community level, at the institutional level, and in relation to power and justice. Some of the categorised elements may overlap, which cannot be avoided entirely.

At the (inter) personal and community level, public officials recognise professional facilitation as an important factor in the success of realizing a co-production process (see also Page et al., 2016; Preller et al., 2017). Here, public administrations have two options: they can either provide training to internal staff or hire an external facilitator to manage the process effectively. Suitable facilitation is essential in mediating between different views, values, and perspectives of stakeholders (Chambers et al., 2021; Knapp et al., 2019; Page et al., 2016; Preller et al., 2017; Reed et al., 2018).

Training internal staff is needed because urban foresters, who have primarily been trained in classical forestry, may lack the specific skills required to engage with wider stakeholder groups and to implement transdisciplinary approaches. They may also be unaware of the benefits and opportunities associated with collaborative approaches. These constraints originate in their education or organisational culture, where the prevailing attitude may be "we have always done it this way" (Jay and Schraml, 2013). Moreover, providing training can help public officials to cope with the complexity of the co-production process, alleviate

feelings of being overwhelmed by the additional workload, and address time pressures mentioned during the interviews.

Alternatively, delegating the responsibility to an external facilitator offers the advantage of providing a more balanced and outsider's perspective, which might help move forward institutional inertia which often exists in public administrations (Munck af Rosenschöld et al., 2014). Yet, relying on an external facilitator may only shift the responsibility of incorporating local community groups into the co-production process to another actor, who may bring their own preconceived vision into the co-production process (Kiss et al., 2022). In addition, organisational learning will be limited if co-creation is outsourced to external actors without proper co-learning between external expert and officials responsible in the municipality for UF-NBS or citizen participation.

Furthermore, the interviewees suggest that a facilitator should have certain characteristics and perform specific tasks. These include sharing knowledge and information, motivating and involving all participants, managing expectations, delegating tasks, building trust, and demonstrating perseverance. Previous studies confirm these results i.e., the availability of information to reduce transaction costs for local communities to get involved (Verschuere et al., 2012). Additionally, research highlights the importance of engaging as many stakeholders as possible as early as possible in the start-up phase of the UF-NBS co-production (Buffel and Phillipson, 2018; Davidson-Hunt et al., 2013; Risvoll et al., 2014). Beyond these results, others have highlighted the need for feedback loops for participants (Schneider and Rist, 2014) and the importance of establishing clear mechanisms for collective decisions (Reed et al., 2018).

Additionally, the participation and/or establishment of networks is crucial for the success of co-production processes and reaching out to non-experts. This applies to internal and external facilitators as well as to the organisations they represent. The reason is that many future partnerships originate from networks, that bring in additional capacities, build trust and decrease costs (Lemos et al., 2018).

At the institutional level (referring to the resources and physical needs), long-term institutionalized commitments, including adequate and continuous funding and resources (time, staff, and materials), to UF-NBS co-production processes are central for its success. Ideally, part of the funding and resources are made available beyond the capital phase (Reed et al., 2018) and beyond election cycles (Chambers et al., 2021; Davies et al., 2017). These results are consistent with previous work that emphasises that funding should align with the goals of the co-production process (Reed et al., 2018) and that there should be sufficient materials (e.g., venues and tools) (Trencher et al., 2014). Regarding UF-NBS, long-term funding is particularly important due to the long growth periods of trees and the time required to potentially transform urban forests. In addition to institutional funding, co-production processes can manage access to additional financial resources, such as charitable or lottery funding, donations in-kind (e.g., voluntary work) to qualify as matched funding, or the creation of new business opportunities (Trencher et al., 2014).

Another critical point for successful co-production is whether municipalities have (positive) experiences with co-production or whether a (local) culture of co-production exists. Municipalities with an existing culture of co-production may have an advantage in overcoming (mentioned) challenges such as different working cultures, limited stakeholder understanding, and low citizen participation. Moreover, if a public administration has no local culture of participation, one should exercise caution when conducting active citizen participation (Reed et al., 2018). However, attention should be paid to avoid stakeholder fatigue by involving different stakeholders in different co-production processes.

At the institutional level, co-production can be greatly improved through the development of adequate institutional structures and support from senior management (Verschuere et al., 2012). Including co-production approaches in urban planning and green infrastructure guidelines can also enhance the effectiveness of the process (Hansen et al., 2022; Whitehead, 2021). Some regional administrations have already established guidelines for community engagement in land management, such as the Brussels Capital Region and the Scottish Government (Scottish Land Commission, 2021; Scottish Government, 2018).

This study showed that a wide range of UF-NBS platforms for knowledge exchange, including participatory activities are used in co-producing UF-NBS (tree plantings, photo competition or tree watering). That is confirmed by Kiss et al. (2022) who call for multiple arenas for discussion and highlight their potential to change the culture of participation. In this regard, prior studies have also noted how beneficial it can be to use digital technologies in enabling stakeholders, particularly the local community, to engage in co-production processes (Satorras et al., 2020; Meijer, 2012).

Lastly, lessons learnt in relation to power dynamics and questions of justice are important considerations in the co-production process of UF-NBS. Those who steer the process (normally those residing over funding or owners of land) need to carefully decide who to involve and how to share their power (Reed et al., 2018). Public officials typically initiate the co-production process, have control over budgets, schedules, and the extent to which other partners are involved in the co-production process, consequently, act from a position of power. This study showed that stakeholders are often excluded from the problem-definition phase and that there is no single case where the problem definition originates from a collaborative process, potentially leading to power imbalances. In addition, from 19 interventions in this study, most (14) remained in a consultation form of public participation according to categorization by van der Jagt et al. (2016). As such, the success of these UF-NBS interventions might be at risk and appear as tokenistic (Kiss et al., 2022). There could be concerns about power-sharing, i.e. empowering local communities too strongly, and about a lack of understanding within some stakeholder groups about the extensive range of urban forest services (Davies et al., 2017). Moreover, an often "top-down" culture still ingrained in public administration (also a change of culture from being defensive towards enabling), a lack of funding and trust between stakeholders makes power-sharing challenging (Kiss et al., 2022). While part of the problem might be related to the fact that those who hold power are reluctant to share it, another obstacle for participation is the sheer difficulty to involve local communities in co-production processes and (again) the scarcity of resources to do so (Van Herzele et al., 2005). Yet, in a context of austerity and state roll-back from urban forest management, exclusion of (marginalized) local groups - and thus a de facto shift of power towards more affluent or educated segments of society - is particularly problematic for democratic decision-making (van der Jagt et al., 2016). To overcome questions related to power imbalances, UF-NBS co-production could therefore benefit from coordinators, as well as the training of staff.

Based on the lessons-learnt in this study, it is possible to formulate immediate policy recommendations. As elicited, investments in the training of public administration staff or ensuring funding for external facilitators is recommended to enhance the success of UF-NBS co-production projects. Long-term institutional commitments should be developed (through establishing guidelines and policies), participation in networks, and prioritising funding and resources (beyond election cycles) are needed for successful co-production. Furthermore, the full range of UF-NBS platforms for knowledge exchange should be used for co-production. Lastly, co-production requires careful planning and citizen participation in early design stages of the process to ensure that outcomes are relevant to all stakeholders involved.

4.3. *Methodological considerations and future research*

Conducting a study across different cultural, regulatory and policy contexts faces certain challenges. One of the difficulties encountered in this study was the nuanced interpretation of the term "co-production" by

respondents, also due to conducting the interviews in different languages. Different interviewees may have understood the concept as co-creation, co-design, participatory processes, or transdisciplinarity. The terminology differs considerably across cultures and contexts, making a conceptual distinction challenging in a practice-oriented environment (Ansell and Torfing, 2021). Despite providing a definition of co-production in our interview guide to foster mutual understanding, some variability in the interpretation and application persists. There is still a lack of uniform terminology in the public domain.

With a small sample size of 22 interviewees about UF-NBS co-production, the findings cannot be considered as generalisable. Yet, they give substantial insight into certain themes, even when considering that reflections were taken from very different stages of the co-production process. Furthermore, the interviews took place in seven European cities, each with very different administrative and regulatory contexts at the local and national level. Therefore, the assumptions made here are not necessarily transferable to other cities or UF-NBS co-production processes. The findings may hold relevance for some cities and UF-NBS co-production processes across Europe, but for others, they may not be applicable.

A further note of caution is due here, as there may be a possible bias in the responses by the interviewees. In the context of NBS, more collaborative governance processes such as co-production and related concepts are en vogue and increasingly being adopted at municipal, regional and international levels, sometimes mandatory by policies or funding guidelines. As public officials are obliged to use these approaches, it may be that they present their views on co-production in a slightly more positive light or with a sense of ambiguity in explaining certain delicate processes or relationships.

Our study initially and purposefully involved selected public officials from the network of the CLEARINGHOUSE project researchers. These public officials were considered as best suited based on their potential to offer insights into the subject and their ability to recommend additional contacts in their municipality relevant to our research, who can otherwise be rare and difficult to reach. Deploying this snowball sampling strategy, we ensured that additional contacts fulfil similar criteria as for the initial list of interviewees, particularly having experience with co-production and urban forestry/urban greening. Additional contacts were also asked to recommend more potential participants at the end of each interview. It is important to bear in mind the possible bias in this method, as it limits the representativity to one single actor, not expanding to a broader population, which may be desirable in the context of UF-NBS co-production, which relies on multiple stakeholders to produce knowledge.

In cross-linguistic studies, there is a potential risk associated with translating interview data. Although, we used machine translations, which may be prone to mistakes, we also ensured that each interview was proof-read by a researchers/native speaker. This approach aimed to account for cultural contexts as far as possible. However, there is still a risk that context-specific nuances could be lost, especially since the researchers were not present during the UF-NBS co-production process. Furthermore, mistakes in technical language specific to certain forestry departments/municipalities and co-production processes may have led to additional translation inaccuracies.

In this paper, we investigated the perspective of public officials, but for future research it would be interesting to triangulate the official's assessment with the perceptions of the stakeholders involved as participants in the process, such as from stakeholders from non-governmental institutions. This would add more perspectives and seems beneficial as co-production is about multiple stakeholders cooperating, and further research including these respondents would be relevant. However, due to time and funding constraints, we opted to focus on the opinions of administrative authorities, as they ultimately decide whether co-production approach is pursued or not, and decide on how the process is run and managed.

Further, it would also be interesting to interview public officials from cities that did not engage in co-production for UF-NBS.

5. Conclusions

This study provided insights into the perspectives of public officials regarding co-production and on how they navigate participatory processes in the context of urban forests as nature-based solutions. We identified two main types of motivations – instrumental motivations, which focus on rational and efficient goal attainment and growing trust, and substantive motivations, which involve filling knowledge gaps and achieving relevant results - as the main drivers behind UF-NBS co-production. Yet, co-production remained predominantly limited to consultation-based forms, and the institutional structures of public administration underwent only marginal transformation and only in rare cases. The study will be of interest to policymakers and actors involved in UF-NBS co-production because it suggests that successful co-production hinges on professional facilitation, participation in network, long-term commitments for funding, staff and materials, comprehensive use of UF-NBS platforms for knowledge exchange, and early citizen involvement.

CRediT authorship contribution statement

Nicola da Schio: Conceptualization, Formal analysis, Writing – review & editing. **Ivana Zivojinovic:** Data curation, Formal analysis, Writing – review & editing. **Silvija Krajter Ostoić:** Conceptualization, Formal analysis, Writing – review & editing. **Andrea Armstrong:** Writing – review & editing, Formal analysis. **Dijana Vuletić:** Data curation, Formal analysis, Writing – review & editing. **Francesc Baró:** Writing – review & editing. **Agata Czaplarska:** Formal analysis, Writing – review & editing. **Arjen Bujis:** Supervision, Writing – review & editing. **Ian Whitehead:** Writing – review & editing. **Dennis Roitsch:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft. **Rik De Vreese:** Conceptualization, Funding acquisition, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests. Dennis Roitsch reports that funding was received by the European Union's Horizon 2020 research and innovation programme under grant agreement number 821242 (CLEARING HOUSE). Futhermore, support was received through supervision by the European Forest Institute and Wageningen University & Research. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Interview questionnaire

Introduction

- First, I would like to thank you for your time and contribution to our research
- With CLEARING HOUSE we are part of the discussion that sees the potential of urban trees to address many urban challenges, the growing demand for more livable cities, and the increasing efforts of governments to realize this potential
- As part of this project we are conducting qualitative research that seeks to shed light on a specific dimension of this phenomenon: the co-production of the urban forest
- By **urban forest** we mean the ensemble of trees that are in and around cities, including parks, peri-urban forests, patches of green, street trees. Other refer to it as urban green, or urban vegetation, but always in a context where trees are central
- By **co-production**, we refer to all projects and initiatives were the government join hands with other stakeholders within other branches of the government, academia, civil society, private sector, citizen groups. We are interested in the ones where at least governments and researchers play a role
- Against this background, we want to hear your perspective and insights on projects that adopted co-production processes and that are focusing on trees, parks or forests in cities. And in particular about:

  - The reasons to take/not to take a co-production approach with regard to the management of forests, parks and trees, as well as the overall ambitions and definitions of success
  - The driving forces and the challenges that are associated with co-production processes, as well as your perceived outcomes for sustainability

- Our study includes about 5–6 interviews in your city and several other cities in Europe and China
- Our interview will take 60 minutes, which we plan to transcribe and analyze.

  - Can we record? Yes/No
  - Do we do need to anonymize your answers and how (e.g. institution, department, seniority, specific position) _____

1. **UF-NBS co-design projects in your city and your experience with co-production processes**

- What is your professional background and for how long have you been working in this position?
- I am aware you worked on the XXX project. are there other projects involving the co-production of the urban forest in which you have participated? Can we briefly list them and introduce them? (e.g. name, objective approach, what has happened…)
- (list projects)
- We'll focus on XX project, but please do not hesitate to mention if the experience there was very different from the other, or similar, or in general if anything stood out

1. **Before the project: designing it and setting the stage**

- When drafting the projects, how did your institution and other actors define the problem to be addressed?

  - *Was it about urban greening, and co-production was taken as a method? Or was it about participation, and urban greening was taken as a theme*?

- Who was involved in initializing and shaping the project from the beginning? Were all main actors from the field of urban greening (forests, parks and tree management) involved? Was anyone not involved, why? Who was the leader of the process if any?
- In your opinion, what was the main reasons that resulted in the adoption of co-production? Were there any possible reasons NOT to go for co-production?
- Is this projects part of a broader strategy to manage trees in the city? What would be the most important policy/plan? Does that strategy mention co-production if so, how?

1. **Implementing and managing co-production process**

- What was the role of your institution? and your role in particular? Were there other government /public actors involved?
- Could you please briefly explain how the project unrolled? What activities (e.g. meetings, workshops, surveys, focus groups…) took place in the project involving co-production?
- Which actors took part in these activities, how? Would you say that all relevant stakeholders were involved, why? If not, who should have been involved, and why that was not the case?
- Were there sufficient resources and capacities, including venues, tools and funds? Who provided these resources? What did every actor bring to the table?
- In your opinion, what worked well during the implementation of co-production process in this project? what did not work? Please make concrete examples
- What were critical elements that helped in taking on the project? what obstacles do you remember having faced? How did you deal with them?
- Can you remember of any dilemma that you encountered while conducting the project? what choices did you have to take and what was at stake
- Were researchers involved? did they provide you with products, publications, services, etc. in an appropriate form and language?

1. **Outcomes. Let's look at the impact of the project**

- What did the project achieve? Please think both about tangible and less tangible results

  - In terms of urban greening (forests, parks and trees in the city)
  - In terms of the co-production process

- Were they in-line with your initial expectations? Where did they fall short? Where have they exceeded them?
- Overall, do you consider this project as a success or not? Please explain both sides of the coin
- Can you list three advantages of having adopted co-production? Can you list three disadvantages too?
- What relationships have been established that inspire future collaborations?
- Has the project gathered feedback from the participants in the co-production process? If yes, could you please tell me if anything stood out? *(Can you send us this if it is part of some project deliverables?)*

1. **Final questions**

- In general (not only the project you have experience with), when would you say that a project of co-producing the urban forest is successful? What are the criteria to define it so? What are the elements that contribute to taking a project to success?
- Let's look the other way around too: would you say that a project of co-producing the urban forest is NOT successful? What are the criteria to define it so? What are the elements that contribute to make a project fail??
- If you were to decide whether to go with co-production or not, what would you choose and in which cases? why?
- What do you think could be better/more effective alternatives to co-production, if any? Why?

Close

- I'll be happy to share with you the transcripts if you like, or the summary of all interviews, and anyway to keep you posted about the next steps of the research in case you came out with other ideas, or you realized I misinterpreted you
- Do you have any person in mind that you think we could interview after you?

Appendix B. Overview of interviewees

ID	Organisation	Unit; Level	Years of experience
ID1	City administration	City official, Planning	20 years
ID2	State Forest Service	Head of Urban Forests	> 2 years (relevant position)
ID3	State Forest Service	Head of Urban Forests (retired)	> 30 years
ID4	City administration	Head of operations	> 20 years
ID5	City administration	Head of department	> 20 years
ID6	Municipal Greenspace Authority	Project management	9 years
ID7	Municipal Greenspace Authority	Management level	9 years
ID8	Municipal Greenspace Authority	Deputy director	10 years
ID9	Regional administration	Project management	> 7 years
ID10	City administration	Project management	6 years
ID11	City administration	Deputy director	> 13 years
ID12	State Forest Service	Project management	17 years
ID13	City administration	Head of department	25 years
ID14	City administration	Project management	20 years (5 years in relevant department)
ID15	City administration	Head of department	16 years
ID16	City administration	Project management	7 years
ID17	City administration	Project lead	8 years
ID18	City administration	Project lead	20 years
ID19	City administration	Head of department	> 16 years
ID20	City administration	City planning	6 months
ID21	City administration	Project management	> 7 years
ID22	City administration	Project management	6 years

Appendix C. : Overview of themes and codes from qualitative analysis

Table 1
Motivations for UF-NBS co-production

Themes	Number of interviewees
Meeting the wishes and demands of residents	3
Filling knowledge or expertise gaps	2
Developing innovative solutions for UF-NBS	2
Building on previous (positive) experience with co-production processes	1
Gaining legitimacy	1
Building awareness	1
Gather public support for projects	1
Inspiration/ideas from other cities	1

Table 2
Enabling factors of UF-NBS co-production

Themes	Number of interviewees
Sharing knowledge and expertise	4
Coordinator	3
Effectively manage different expectations	2
Mentality of perseverance	2
Clear time limitations	2
Creating events for all generations	2
Using digital technologies	2
Being flexible and adaptable	1
Mutual benefits for all actors involved	1
Use of non-technical language or jargon	1
Creating a sense of ownership and responsibility	1
Creating a sense of future importance	1
Delegation	1
Scale of the project	1
Public/private boundaries can be blurred	1
Raising civic awarenes	1
Education through action	1
Positive cost-benefit analysis of co-production	1

Table 3
Impeding factors of UF-NBS co-production

Themes	Number of interviewees
Time constraints, constant pressure, competing pressures	*4*
Dealing with complexity	*3*
Challenge of representation	*3*
Different and competing valuations of nature	*3*
Different or contradictory views of co-production	*2*
Power imbalances	*2*
Low levels of civic participation	*1*
Different work cultures	*1*
Citizen/Community constraints	*1*
Digital technologies	*1*
Seasonal pressure	*1*
Technical language and jargon	*1*
Lack of consultation - tokenistic	*1*
Co-creation becoming political	*1*

Table 4
Advantages of UF-NBS co-production

Themes	Number of interviewees
Networking/Collaboration	4
Reaching common goals	3
Exchange of knowledge and skills	3
Involving diverse actors	2
Embracing an audience through real participation	2
It is a learning process	2
Makes a project well received, with less conflict	1
Levelling out the extremes	1
Local relevance	1
Creates a sense of ownership among users of a green space that leads to less vandalism	1
It brings social cohesion	1
Better understanding among those involved	1
Possibility to raise awareness	1

Table 5
Disadvantages of UF-NBS co-production

Themes	Number of interviewees
Time consuming process	*6*
Group dynamics, including contradictory interests	*4*
Not producing desired change/meeting expectations	*4*
Insufficient staff and financial resources	*3*
Lack of facilitation	*3*
Biased participants	*2*
Challenging to involve people	*2*
Communication issues	*2*
Loss of trust	*1*
When co-production involves too complex a topic (e.g. climate change)	*1*

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