



City-civil society dynamics in urban green infrastructure development in Munich: governance features and their impacts

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ABSTRACT

Global climate change and urbanization exacerbate challenges like biodiversity loss and environmental injustice. Urban green infrastructure (UGI) offers ecological, social, and economic benefits, fostering resilient and sustainable cities. However, UGI development is significantly hindered by the limited collaboration between governmental and non-governmental actors.

Market, state, third sector and civil society engage in UGI governance modes that range from hierarchical to non-hierarchical. The interplay between city administrations and civil society is particularly crucial, as it enhances democratic decision-making, transparency, and alignment with strategic UGI planning goals.

Applying the Environmental Governance Framework, this study analyzes seven UGI interventions in Munich representing different governance modes to explore the factors influencing city-civil society interactions throughout the UGI development.

Four shared factors emerged: limited information distribution during idea development, which plays a dual role as both a barrier and an enabler, knowledge ownership, limited motivation to collaborate during implementation, and ambiguity in responsibilities spanning both implementation and management phases.

The study highlights the role of spatial factors in shaping actor arrangements and reveals that governance modes shift throughout the UGI development process, underscoring the importance of prioritizing shared barriers, as they impact both governance modes.

To enhance city-civil society interactions, we advocate for a systems thinking approach that prioritises shared factors while moving beyond addressing barriers in isolation toward a systemic understanding of governance interactions.

This approach supports scholars and practitioners in identifying pathways to enhance city-civil society interactions, ultimately contributing to more adaptive and inclusive UGI governance, regardless of the governance mode in place.

1. Introduction

Rapid urbanisation has resulted in significant environmental and societal challenges that are exacerbated by climate change, leading to biodiversity loss, increase of environmental injustices, and a decline of social cohesion [1]. Urban green infrastructure (UGI) - defined as multifunctional networks of natural spaces, such as parks, street greening, gardens, institutional green spaces [2,3] - is recognised as a key strategy for addressing these challenges, as it provides both ecological and social benefits, ultimately helping to create resilient and sustainable cities [4]. The development of UGI, however, is hampered

throughout the design, implementation, and long-term maintenance by its governance [5,6]. Some of these governance challenges arise from the complex interactions between different actors in decision-making processes on how this natural resource is managed for the planning and management of UGI [7,8].

Actors can be classified as “civil society” - not legally bounded individuals; “state” - representatives of formal governmental organisation, where “city” is an important actor responsible for the local governance; “market” - private, for-profit formal organisations; and the “third sector” - representatives of legally bound structures such as research institutions, churches, NGOs, and others that do not fit into the first three

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categories [9].

These actors interact in the decision-making process on UGI development in various constellations, called governance modes [10–12]. Governance modes can broadly be divided in two main categories: hierarchical, where authorities make more top-down decisions and take primary actions, and non-hierarchical, where decision-making is delegated or shared with non-governmental actors [13]. In UGI development these two types of governance modes often coexist [14].

Within these governance modes, city-civil society interactions play a particularly important role, as they may result in improving the overall outcome of UGI interventions Buijs et al. [15].

Previous research highlighted many essential reasons for engaging and collaborating with civil society when developing UGI on public land. Based on a recent systematic literature review by Sarkki et al., [16], these reasons span from enhancing democracy, addressing inequality and social justice, fostering a greater sense of place and acceptance to the ability to catalyze transformative change by influencing existing governance structures and by creating new collaborative arrangements [17]. Furthermore, the creation of a multifunctional UGI network requires reliance on diverse types of knowledge. Civil society can bring local knowledge, such as how they value and use the area and personal perceptions, and highlight the areas of potential conflicts of interest often lacking in top-down planning systems [18,19].

Additionally, cities need access to private land [20], as operating within the boundaries of public land, they cannot develop UGI as a multifunctional network that is required by definition to provide ecological and social benefits. Individuals or groups may initiate UGI interventions or prioritize different uses on the private property they are legally responsible for [21]. While private actors can potentially contribute to the expansion of the UGI network beyond public land, the UGI they implement may not realize its full environmental and social potential. Moreover, city administrations may overlook such interventions on non-public land when developing the UGI development strategies, leading to UGI network fragmentation and disruption of its ecological functions [2]. Interactions with civil society thus provide an overview of ongoing non-governmental UGI interventions, including their quality, and help to understand whether these interventions align with the city's strategic UGI planning goals [16].

The positive outcomes of city-civil society interactions within different actor configurations throughout UGI development processes [22] are recognised across different urban contexts including Germany, Sweden, Australia, and Kenya [23–26]. Yet, in practice these interactions are still rare and vary across cities and cultures [27,28].

Both city administration and civil society actors can take on different roles from intervention to intervention as well as across development phases within an UGI intervention, which usually goes through 'design,' 'implementation,' and 'management' before it reaches its intended outcome [20,21]. From initiators and co-creators to observers or facilitators - there are also times when they are not involved at all [1,2]. For instance, while co-implementation may not be necessary for highly technical UGI interventions, collaborating with civil society in long-term co-maintenance can be crucial - particularly as maintenance remains a persistent challenge for UGI longevity [1]. Frequency of interactions between actors tends to be higher at the initial and later phases but lower during implementation [22]. This changing frequency indicates the influence of changing factors on actors' interactions, such as resource availability or regulatory framework at force.

Thus, there should be a better understanding of the governance context shaping actor arrangements in order to understand when, how, and to what extent city-civil society collaboration is appropriate, depending on the governance mode and development phase.

The factors influencing actors' interactions can either be obstacles to the adoption of UGI and its implementation, or enablers - factors that promote UGI development [29]. Previous research has explored various barriers focusing on UGI mainstreaming [6,23,24], governance [21,25,26], and broader UGI implementation [30–33].

Research has identified different types of barriers for city-civil society interactions in UGI development, such as lack of resources, communication issues, lack of suitable participation processes, diverse structural conditions and others [34,35]. These different barriers may be more significant at different phases [36]. Moreover, besides merely identifying individual barriers, research showed that it is essential to understand how they influence one another. For example, lack of knowledge brokers barrier appears to play a critical role, as effectively addressing it can help overcome various other barriers such as lack of connection actors across scales or translation of UGI related knowledge across disciplines [33]. Additionally, there is a need to focus on structural conditions causing the barriers. For example, challenges in citizens engagement can stem from limited experience in involving them in UGI development or from a lack of financial resources and effective incentive methods depending on the context [6].

The various studies have analysed the diverse factors shaping city-civil society interactions [31,37–39]. As much research has focused on non-hierarchical modes as the preferred governance approach for UGI development [38,40,41], it lacks in differentiating between those mode-specific (unique to hierarchical or non-hierarchical governance mode) and those shared across both modes at different UGI development phases. For instance, barriers observed in UGI interventions under non-hierarchical modes during a particular phase may differ substantially from those encountered in hierarchical modes. In the Latin American context, for example, hierarchical modes often face challenges such as inadequate government management or a shortage of city resources, whereas non-hierarchical modes may struggle due to a lack of formal recognition by city authorities or the absence of sanctioned measures [42].

In interventions that display both hierarchical and non-hierarchical governance modes over time, failing to differentiate between mode-specific and shared barriers may lead to addressing only those obstacles pertinent to a particular governance mode at a particular moment in time. This oversight, derived from a too static view of governance processes, can hinder comprehensive governance reforms that acknowledge the plurality of existing modes [6]. Consequently, identifying and addressing these shared barriers over time is crucial to reveal areas for improvement and leverage existing strengths to foster better city-civil society interactions in UGI governance.

This study uses an environmental governance framework that focuses on transforming decision-making processes to achieve socio-environmental urban sustainability [e.g. [43,44]]. Approaches to environmental governance have increasingly focused on addressing issues such as resource scarcity, management, allocation, accessibility, while emphasising the city-civil society interactions in decision-making processes as a key aspect [45,46]. This framework, through its emphasis on "reflecting on more collaborative and integrative modes of governing urban nature" [47], enables us to understand the shared factors that shape city-civil society interactions at each individual phase of UGI development and to address two key knowledge gaps:

- (1) distinguishing shared barriers and enablers that impact interactions across both hierarchical and non-hierarchical governance modes from those specific to each mode, and
- (2) exploring the differences and commonalities of these shared barriers and enablers across various phases of UGI development with their respective governance modes.

By providing such insights, this research aims to support scholars and practitioners in understanding the governance context under which city-civil society collaboration for UGI development is (not) happening and identify pathways to enhance it from a city administration perspective. Overall, it seeks to answer the central research question: *What governance barriers and enablers influence city-civil society interactions across both hierarchical and non-hierarchical modes throughout the UGI development process, and how?*

2. Theoretical framework: environmental governance, modes and their features

To examine inter-actor governance dynamics, this study employs the Environmental Governance Framework (EGF) developed by Driessen et al. [48]. Previously this framework was used in the fields of agriculture to analyse the actors' arrangements to enhance nature conservation [49], in water governance to understand actor relations for better flood risk management [50] and to understand which modes of governance are needed to achieve sustainable urban regeneration [51].

The EGF offers more detail on governance features compared to previous frameworks, such as Collaborative Governance or the Policy Arrangement Approach, which have been adopted to understand actor's arrangements within UGI development [14,52–55]. Additionally, EGF was used to address the dynamics of changing actor arrangements over time, therefore it is also useful to answer the second research question, enabling better identification of barriers and enablers across different phases of UGI development.

Driessen et al. [48] defined EGF through five archetypal hierarchical and non-hierarchical modes of governance: centralised, decentralised, public-private partnerships, interactive and self-governance (see Fig. 1).

Hierarchical modes, such as centralised and decentralised, are those in which governmental actors take the lead and non-governmental actors act as recipients of such actions. Public-private partnerships (PPP) also represent a hierarchical mode, as here cooperation occurs between the city and market actors. In contrast, non-hierarchical modes, such as the interactive mode, involve participants from civil society and the third sector on an equal-rights basis. Finally, the governance mode in which non-governmental actors play a steering role within set government rules is called self-governance.

The EGF includes a descriptive list of 11 features defining governance modes categorised in three dimensions: "actor," "institutional," and "content". These features function as an analytical tool, helping to reveal how different governance factors influence inter-actor interactions, specifically city-civil society actors, acting either as barriers or enablers to city-civil society interaction processes.

Originally, the list of features was developed to characterise the modes of governance in environmental policy-making at various levels from supra-national to local. Since this research focuses on the governance of physical UGI interventions within urban areas, the initial framework was adjusted to the needs of the study (see Table 1).

The "actor dimension" refers to the characteristics of key participants involved in UGI development within a specific context. The **initiating actor(s)** explores the type of actor responsible for initiating the UGI intervention, which can include the city, market, third sector, or civil society [9]. The **actor's position** indicates their stance within a collaborative effort, ranging from autonomy to dependency in decision-making processes. Initially, the **policy level** feature centered on the levels of decision-making within policy making processes. However, for this research, it was reconsidered as spatial levels of **decision-making** e.g., city, neighbourhood, and site-specific - to better align with the analyses of physical interventions. The **power base** feature remained as initially defined, referring to the distribution of tangible and intangible resources among the involved actors, such as time, knowledge, finance, land ownership, and other.

The "institutional dimension" highlights how interactions among

Table 1

Adapted research framework [based on [48]].

Adapted environmental governance framework			
Feature	Status	Definition	Sources
Actor dimension			
Initiating actor(s)	Altered	→ The actor type initiating the UGI development	[9]
Actor position	Unaltered	Position the actor takes within the interaction	[48]
Policy level → Decision-making level	Altered	→ Levels at which actors made decisions about UGI development	[43]
Power base	Unaltered	Tangible or intangible resources that actors used to participate in interactions	[48]
Institutional dimension			
Model of representation	Excluded	Corporatist, Pluralist, Partnerships	[48]
Rules of interaction	Unaltered	Established rules of interaction and exchange between actors	[48]
Mechanisms of interaction	Unaltered	Established way of social interaction between actors	[48]
Content dimension			
Goals and targets	Unaltered	Objectives pursued and their alignment	[48]
Instruments	Unaltered	Types of measures or tools used for UGI development	[48]
Type of knowledge	Unaltered	Type of knowledge used for the UGI development	[48]
Policy integration	Excluded	The extent of policy integration	[48]

actors are structured. This dimension of the framework includes two features: **rules of interaction** and **mechanisms of interaction** between actors. **Rules of interaction** highlight whether city-civil society interactions are formally structured through laws, policies, and contracts, or informally through unwritten traditions and norms. **Mechanisms of interaction** refer to established approaches, such as bottom-up or top-down, that guide the decision-making processes. The third feature, which focuses on **models of representation** that range from pluralist to partnership models, was excluded due to its inapplicability to physical interventions.

While initially, the features relating to the "content dimension" were used to analyze how the internal organizational structure influences the development of the content of policies, in this study, these features were interpreted in relation to dynamics between city-civil society actors when developing the content of UGI interventions. Thus, internal governmental and non-governmental organizational rules and processes within individual entities are not the focus of analysis here.

The feature **goals and targets** focusing on what objectives the involved actors pursue and whether they are aligned or not. The **Instruments** feature explores types of tools and methods such as informational or legal used for actor interactions throughout the UGI development. **Types of knowledge** distinguish between expert, technical, or lay used in the specific UGI interventions. In this research, the **policy integration** feature was omitted, as it is not applicable to the physical nature of the UGI interventions.

Thus, in modifying the initial framework, two features were revised, two features were removed, and the remaining features were retained as defined by Driessen et al., [48]. Consequently, the adjusted framework

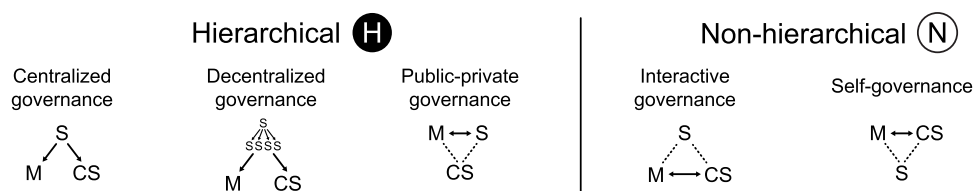


Fig. 1. Archetypal forms of governance modes based on EGF split into hierarchical and non-hierarchical modes [from [48]].

now comprises 9 features. Table 1 illustrates the definitions of each feature.

3. Methodology

3.1. Case study: Munich

This study applied the EGF to the case study of Munich to gain insights from a real-life context [56]. The significance of UGI development for Munich is reflected in key urban planning documents such as *Perspektive Munich*, the overall vision for urban development, and *STEP 2040* as an integrating spatial framework [57,58]. The development of UGI interventions in Munich is driven by an array of governmental and non-governmental actors, and can be described as a centralized governance, characterised by a strong role of the state and a high degree of institutionalisation and hierarchy [59]. The city administration has taken steps toward opening opportunities for civil society to be involved in the processes by providing financial incentives for greening private gardens, mandating public participation in public square development, and promoting green sponsorship opportunities. However, how these city and civil society collaborations are structured throughout the UGI development process remains unclear.

To explore the case study of Munich, we identified units of analysis, sub-cases within the broader study, that helped to answer the research questions and establish boundaries of the case study analysis [56].

3.2. Units of analysis

For the purpose of this study, we defined the units of analysis as physical UGI interventions initiated by governmental and non-governmental actors [60] in 2013 or later to ensure insights into the latest developments in UGI. The identification of units started with an online stakeholder mapping workshop on 10 June 2022 within the [*the name is concealed for anonymity*] project, funded under the EU Horizon 2020, aimed to activate nature-based solutions (NbS) for a just transition to low-carbon cities. Within the 1.5 hours workshop, two representatives from the City of Munich, Department of Urban Planning and Building Regulations (Referat für Stadtplanung und Bauordnung), and two researchers from the [*concealed for anonymity*], including the main author, identified actors active in UGI development in Munich. The resulting list of sixteen non-governmental environmental and community organisations was expanded through a desktop study to 22 units, all initiated by third sector actors. In addition, five municipal departments were identified as relevant. Eleven representatives of these departments were interviewed during an internship at the Department of Urban Planning and Building Regulations of the City of Munich, from January 9 to January 27, 2023, to identify units initiated by city, market, and civil society actors. This step resulted in an additional 198 units. Together with the units identified in the workshop, this resulted in a total of 220 units.

To select suitable units for the purpose of this study, the following selection criteria were formulated:

- i) the unit was at the “management” phase at the moment of analysis, to explore the changes over three phases;
- ii) the unit was implemented on ground level, thereby excluding UGI building interventions such as green roofs or facades;
- iii) basic information on implementation status, initiator type, or the land ownership status should be available.

The screening of 220 units excluded 68 units that were still in the process of implementation, 8 units that did not exist (anymore), 59 units that were green building interventions, and 20 for which we could not identify the current state, initiator type or the land ownership status, resulting in the selection of 65 units. Included units were allocated within a matrix indicating initiating actor and land ownership - key

parameters for identifying governance arrangements [61] and distinguishing governance modes influenced by the rules of interaction on private and public lands [62]. This approach ensured representation of a broad spectrum of hierarchical and non-hierarchical governance modes.

Identifying units on private land proved to be more challenging due to less publicly available information. Of the 35 units on private land, 30 resulted from the ‘Green in the city’ funding programme, which encourages private landowners to regreen their courtyards, roofs, and facades. However, this information was not publicly accessible due to data privacy regulations and was provided by the municipality only for the purpose of this research. A city representative responsible for the City’s Financial Program approached the private landowners (civil society) participating in the program to identify their interest to participate in an interview.

For other units with available contact details, emails were sent during April-May 2023.

We received responses from nine initiatives. Preference was given to seven units for which at least two interviews with different involved actors could be secured, and where respondents were open to long-term communication (see Appendix B for the full list of the 65 units).

While some selected interventions can be described as pilot initiatives regarding technical experimentation with UGI design and implementation, they are not classified as policy experiments. No changes were made to existing policy frameworks; rather, the UGI interventions were initiated and developed within their current boundaries.

3.3. Data collection

3.3.1. Semi-structured expert interviews

For an in-depth understanding of the selected seven units, seventeen semi-structured interviews were conducted [63] within a total of eighteen actors. The first seven interviews were held with the initiating actors of each unit. To validate findings and provide an alternative perspective, ten further interviews were conducted with actors involved in one or more development phases of the research units.

As far as the main objective of the research was to understand how UGI governance can be changed from the perspective of the city administration, civil society actors were interviewed only when they served as initiators of a unit of analysis. Broader engagement with civil society was limited due to the difficulty of identifying individuals and grassroots initiatives lacking formal legal status and the lack of accessibility to their contact details due to data protection regulations.

The interviews, conducted between April 2023 - May 2024, lasted between 30 and 90 min. The method was selected based on the respondent’s preference, including face-to-face, online through video conferencing software (e.g., Zoom, Webex), and telephone interviews [63]. Email correspondence was used to follow up with respondents, if further questions arose [63]. Prior to the interview, respondents were asked verbally for their permission to record the conversation, and whether they wished to stay anonymous. If permission to record was not given, the interviewer made detailed notes.

A theory-driven interview guide based on the governance features of the adopted EGF was designed. (see Appendix A for the ‘Interview guide’). While structured around EGF, the guide allowed flexibility to follow-up questions for further clarification [63]. An overview of the respondents, the applied data collection technique, and the resulting data per respondent can be found in the Appendix C.

3.3.2. Secondary sources

A variety of secondary sources was collected for units to supplement the interview data. These encompass competition briefs, strategic policy documents, meeting notes, and municipal resolutions. A comprehensive list of sources used is available in Appendix C.

3.4. Data analysis

The collected data from interviews and secondary sources were analysed through a qualitative content analysis process [64] using the MAXQDA software tool. We applied the “template analytical technique” [65], wherein a coding list is developed based on existing theory. For this study, the governance features of the adapted EGF served as the coding list to deductively code the collected data. Additionally, we applied inductive coding to extend understanding of the features that hinder or enable city-civil society interactions.

The initial round of deductive coding helped to identify the relevant governance modes across the different UGI development phases. A second round of deductive coding focused on identifying the governance factors acting as barriers or enablers for city-civil society interactions. A final round of inductive coding was conducted to define additional factors that did not conform to the pre-set framework.

Relevant material was paraphrased, grouped, and summarised on memo cards, then transferred into a working document, where it was critically reviewed and reassigned to the relevant modes and UGI development phases as needed. A table was then manually produced to summarise the findings (Table 2).

4. Results

Before addressing the research questions, we provide contextual information for the subsequent analytical results. §4.1 outlines the governance modes for each unit at every UGI development phase. §4.2 introduces additional features influencing city-civil society interactions. These steps enable the examination of governance factors that acted as barriers or enablers across both hierarchical and non-hierarchical governance modes, directly addressing the primary research questions in §4.3.

4.1. UGI units, governance features and governance modes

The analysed units showed that there were some governance features (e.g., goals and objectives) that remained constant, while others could change during the UGI development process, depending on the unit (see Appendix).

Within the 3500 Tree Program unit, a standout characteristic was identified in comparison with the other units - namely, the “type of knowledge” feature. This was the only intervention in which the city administration was dependent on local lay knowledge from citizens at the initial phase of UGI development. At the point when local knowledge was no longer needed and the city was no longer dependent on citizens’ support, the unit demonstrated a clear transition from a non-hierarchical to a hierarchical mode (see Table 3). Additionally, when examining barriers and enablers across modes, it is important to recognize that this unit may contribute data to multiple modes.

4.2. Governance barriers and enablers for city-civil society interactions

26 governance factors influencing city-civil society interactions were identified (see Appendix D), where 22 factors were derived deductively, while 4 additional features, related to the spatial dimension, were identified inductively. Notably, the *initiating actors* feature of the EGF was not mentioned, likely due to respondents not perceiving the initiated actor as a barrier or enabler in itself. Features related to the spatial dimension are namely type, size, location and function.

UGI type includes types with distinct characteristics such as parks, street trees, or gardens. This was seen in the Oak of the World unit, where a district committee representative noted that donors opted out of financing the tree planting because they were concerned about the inconvenience of the trees shedding leaves in the fall.

Within the Colourful Ribbons unit, the **UGI size** was observed to potentially influence civil society engagement. An environmental

organization representative noted that smaller green plots are more manageable for volunteers over time, while larger ones often become infeasible, particularly for tasks like watering during the summer.

UGI location in relation to its accessibility for local residents has been observed as a potential enabler of their engagement. The visibility of the Phenological Garden unit was associated with instances where passersby inadvertently fostered informal interactions - an effect potentially amplified by the circumstances of the Covid pandemic, which may have motivated greater civil society engagement.

Finally, the **UGI function** has possibly influenced city-civil society interactions within the Phenological Garden unit. According to respondents, its educational purpose - to provide local students with practical knowledge about plants and the environment, facilitated cooperation between the garden’s initiators (third sector), students (civil society), and the district committee (city). This educational purpose secured funding from the district committee, as the garden’s objectives aligned with broader neighborhood interests.

4.3. Types of barriers and enablers

Out of the 26 hindering and enabling governance factors, three different types at each individual phase were revealed: *mode-specific* - factors exhibiting a consistent pattern within either exclusively hierarchical or non-hierarchical governance modes; *unit-specific* - factors identified singularly within individual units; and *shared* - factors observed to occur across units representing both hierarchical and non-hierarchical governance modes.(Table 4).

4.3.1. Shared barriers and enablers for city-civil society interactions

4.3.1.1. The selection and execution of methods for city-civil society interactions at the idea development phase. During the idea development phase, the choice and execution of suitable methods for actor interactions was associated with the perceived presence of city-civil society collaboration.

The hindering influence was exemplified by the Artur-Kutscher Square (hierarchical) and Private Front Garden (non-hierarchical) units. In the Artur-Kutscher Square unit, efforts to engage civil society in decision-making regarding the square’s redevelopment were minimal. Informational leaflets were poorly distributed to local citizens’ mailboxes by the district committee, and although the committee office was open to receiving feedback, this opportunity was not clearly communicated. A lack of communication coincided with limited civil society participation in the intervention’s information session.

A city representative connected the inadequate engagement to the project being initiated under a previous administration that lacked established mechanisms for civil society participation. This unit illustrates how outdated governance structures and lack of coherence in both the approach to and level of civil society involvement within existing formal rules were associated with inadequate communication strategies, which were perceived as contributing to limited civil society involvement.

In the Private Front Garden unit, the garden owner, facing challenges with garden design due to limited knowledge about suitable plants and a small plot size, was seeking support from a local garden center rather than the city administration. The owner explained that this choice was due to limited awareness of available informational exchange opportunities. The garden owner suggested that if the city is open for such exchange, it should improve the dissemination of information, for example by partnering with local horticultural retailers where citizens may seek advice and purchase plants. A city representative acknowledged the challenges of effectively reaching civil society, despite efforts to promote available programs through channels like social media and local newspapers, and noted that citizens often remain unaware of these opportunities unless actively seeking them out. This unit highlights that

Table 2
Selected units of analysis.

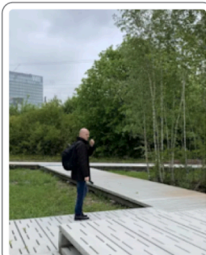
	City	Market	Third Sector	Civil Society
Public land	 3500 trees In October 2020, the City Administration of Munich contacted 25 district committees to involve civil society in identifying potential spots in public spaces for a tree-planting initiative, aiming to plant 3500 new trees. Through this outreach, local input was gathered to compile a list of possible planting locations. Once the proposed locations were finalised, the City Administration took over the responsibility for implementing and managing the initiative. It remained unclear to what extent civil society input was utilized, and no subsequent community engagement was conducted.	 Artur-Kutscher-Square Initiated by the district committee, Artur-Kutscher-Square became part of the city's neighborhood redevelopment program, aiming to enhance the square's overall user experience by reducing parking, expanding public space, and introducing more greenery and trees. Although the local civil society was formally informed about the design concept, the city retained sole responsibility for implementation and management, with limited further communication or engagement of the community.	 Blühende Bänder The research project Colourful Ribbons investigated the impact of roadside greenery on the population of wild bees and other pollinators, examining whether such enhancements contribute to biodiversity enhancement. 80 locations across Munich were transformed into near-natural, climate-adapted flowering areas from 2019 to 2022. The research idea was developed solely by the research institution, with implementation carried out in negotiations with the City Administration. Civil society became primarily involved during the maintenance phase, contributing to the ongoing care of these newly established flowering areas.	 The Oaks of the World The Oaks of the World is a project initiated by Christian Vogt, a citizen passionately committed to environmental protection. Its overarching goal is to plant a total of 333 climate-resistant oak trees throughout Munich as a measure against climate change. With support from public donors and in collaboration with the City Administration, five oak trees have already been planted in District 19. Under the terms of the agreement, Christian Vogt is responsible for watering these trees during their initial years, after which they will transition to the City of Munich's standard maintenance program.
	Private land	 Baumkirchen Mitte Landscape Park Baumkirchen Mitte Landscape Park lies within a conservation-protected area and was redeveloped as part of a new neighbourhood development plan led by a real estate company in collaboration with the City Administration. Recognizing its ecological significance, nearly half the area was preserved and left undeveloped, allowing visitors to experience sensitive flora and fauna via footbridges and viewing platforms without disturbing the environment. Civil society was involved in contributing feedback on ideas proposed by landscape firms, however implementation and park maintenance remain under the responsibility of the real estate company until it can be transferred to the City Administration	 Phenigenic Garden In 2018, the Phenological Garden was launched on church-owned land to address local biodiversity loss. Featuring native plant species adapted to regional conditions, it offers a year-round food source for insects and serves as an educational space. Conceived during the COVID-19 pandemic, the project attracted local citizens to participate, due to lockdown restrictions. Although the church secured district committee funding for implementation, maintenance remains with church employees, leaving no further civil society involvement.	 Private Front garden In 2019, work began on transforming a roughly 20 sq. m. front garden belonging to a terraced family home. Designed to create a welcoming entrance, the project incorporated permeable surfaces, bordering plants near the neighbor's garden, low-rise shrubs, and potted greenery. The homeowner sourced ideas from a local garden center and hired a professional for soil preparation, taking on all subsequent maintenance responsibilities. No involvement from the City Administration occurred during the project.

Table 3

Research units and their governance modes at each development phase H - hierarchical; N - non-hierarchical.

Name of the Initiative	Development Phase		
	Idea development	Implementation	Management
Private Front Garden	N	N	N
Oaks of the World	N	N	N
3500 Tree Program	N	H	H
Phenological Garden	N	N	N
Colourful Ribbons	N	N	N
Artur-Kutscher Square	H	H	H
Landscape Park Baumkirchen Mite	H	H	H

personal motivation among citizens, in addition to clear communication, can play an important role in effective information dissemination and in enhancing city-civil society interactions - a unit-specific factor identified as both enabling and hindering non-hierarchical units.

In contrast, the Artur-Kutscher Square (hierarchical) also demonstrated how appropriately chosen methods can potentially enable city-civil society interactions. According to the city representative, visualisations of the proposed redevelopment design, although they were initially developed without civil society input, were used during a formal informational session and were perceived to facilitate dialogue with attendees and foster consensus around the design concept. Despite the limited number of participants, city representatives indicated that this tool significantly improved interaction with civil society.

A similar effect was demonstrated by the Oaks of the World unit (non-hierarchical), where an expert event provided the context for initiating city-civil society interactions. During one such event, an individual actively involved in Munich's environmental initiatives was introduced to the district committee. This direct connection, along with the individual's recognised technical knowledge and aligned interests in bringing more trees to the neighbourhood, was perceived to foster trust and facilitate further discussions around the Oaks of the World initiative.

4.3.1.2. City administration's motivation to interact with civil society at the implementation phase. A lack of personal motivation among city administrators to engage non-government actors presented a shared barrier at the implementation phase. While this barrier was clearly evident in the analysis, it was often influenced and intertwined with broader factors.

In the 3500 Tree Program (hierarchical) unit, the city's limited interest in civil society engagement was described by the respondent as a combination of perceived complexity and bureaucratic hurdles that deviated from established processes. The city representative noted that combining resources, such as municipal funds with public donations for the tree planting was considered impractical due to extensive approval processes with additional personal resources required, which the city administration currently lacks and which might need the Lord Mayor's endorsement. These factors were perceived to influence the motivation to initiate such collaborations.

In the Colourful Ribbons (non-hierarchical) unit, the decline in the personal motivation of the appointed project leader from the city administration was considered to hinder the intended collaborative approach involving the city, the third sector, and civil society. While the

specific reasons behind this loss of motivation remain unclear, the respondent noted that the city's diminished involvement coincided with fewer discussions and reduced communication dynamics overall. Civil society was eventually involved in implementation by the third sector, however, communication with the city administration remained inefficient, highlighting ongoing barriers to effective interaction.

These units illustrate that, while a lack of personal motivation from the city administration side was a shared barrier across governance modes, it represents a surface-level challenge, with its underlying reasons varying from unit to unit, requiring tailored solutions. This variation highlights the multifaceted nature of barriers to city-civil society interactions, reflecting the broader governance complexities.

4.3.1.3. Technical knowledge ownership at the implementation phase. The internalization of technical knowledge by the city administration and research institutions emerged as another shared barrier during the implementation phase.

In the 3500 Tree Program (hierarchical), the city administration retained control over technical data, such as underground infrastructure information, and relied on internal expertise in the tree planting process, reinforcing a top-down decision-making approach. Although citizens were invited to suggest tree locations initially, the final decision was intentionally retained with the city. Implementation was outsourced to expert gardening companies, who executed predetermined planting specifications established by the city. Although this centralised technical knowledge control allowed the city administration to independently develop the project, it potentially impacted transparency and inclusivity. Citizens remained uninformed about the criteria for selecting tree locations, the decision-making process, and project progress, leaving them feeling disconnected from the process. While technical knowledge ownership by the city administration is a shared barrier, this unit highlights the need for transparent communication about the decisions made when processes exclude civil society involvement - the unit-specific factor within hierarchical mode.

A similar dynamic was observed in the Colourful Ribbons (non-hierarchical). While the third sector acted as a mediator in city-civil society interactions, civil society engagement during the implementation of the green patches remained limited, despite its interactive governance nature. The research institution, which initiated the project, maintained communication with the city administration, as decisions required municipal approval due to the use of public land. However, the research institution's control over the scientific knowledge and specific implementation requirements considered essential to achieving the

Table 4

Factors that functioned as shared or mode specific barrier or enabler at each individual phase of UGI development, with the condition presenting their role highlighted in bold.

B - barrier; E - enabler, N - non-hierarchical, H - hierarchical.

Development phase	B	Type	Research Unit	Factor
	E			
Idea development	B	Shared	Artur Kutscher Square	Appropriate or not appropriate selection of methods for city-civil society interactions.
	E	Shared	Private Front Garden Artur Kutscher Square	Appropriate or not appropriate selection of methods for city-civil society interactions.
			Oaks of the World 3500 Trees Program	
	B	Mode specific H	Artur Kutscher Square	Presence or absence of coherence in civil society involvement within established formal rules of interaction.
			Baumkirchen Landscape Mitte Park	
	B	Mode specific N	Private Front Garden	Presence or absence of established formal rules governing actor interactions.
	E	Mode specific N	Phenological Garden Colourful Ribbons	Presence or absence of dependency among actors on each other's resources.
			Oaks of the World 3500 Trees Program	
	E	Mode specific N	Oaks of the World	Presence or absence of knowledge within civil society that is needed by city administration.
			3500 Trees Program Oaks of the World	Bidirectional or unidirectional processes towards the same goal
Implementation	B	Shared	Artur Kutscher Square	Presence or absence of technical knowledge ownership by non civil-society actors.
			Colourful Ribbons 3500 Trees Program	
	B	Shared	Colourful Ribbons	Presence or absence of motivation within the city administration to engage with civil society.
			3500 Trees Program Artur Kutscher Square	
	B	Shared		Ambiguity or clarity in the allocation of responsibilities across involved actors.

Table 4 (continued)

Development phase	B	Type	Research Unit	Factor
	E			
			Colourful Ribbons 3500 Trees Program	
	B	Mode specific N	Colourful Ribbons	Presence or absence of technical knowledge within the civil society.
	E	Mode specific N	Oaks of the World Colourful Ribbons	Presence or absence of established formal rules for city-civil society interactions.
	E	Mode specific N	Oaks of the World Phenological Garden	Aligned or not aligned goals
	E	Mode specific N	Oaks of the World Colourful Ribbons	Presence or absence of land ownership by actors.
	E	Mode specific N	Oaks of the World Phenological Garden	Presence or absence of financial resources available to actors.
	E	Mode specific N	Oaks of the World Colourful Ribbons	Presence or absence of established informal norms governing actor interactions.
Management	B	Shared	Oaks of the World Artur Kutscher Square	Ambiguity or clarity in the allocation of responsibilities across involved actors.
			Colourful Ribbons 3500 Trees Program	
	B	Mode specific N	Phenological Garden	Presence or absence of specific types of knowledge within civil society.
			Colourful Ribbons Phenological Garden	
	B	Mode specific N		Presence or absence of sufficient time availability among actors.

initiative's objectives was perceived to limit citizens' inclusion in both collaborative decision-making and co-implementation activities. This was reflected in the initiator's (third sector) acknowledgment that, prior to 2023, he implemented patches independently, as seeding and management needed to be standardized to meet requirements of his experiments. This suggests how prioritisation of technical project needs or targets may impact the extent to which civil society is able to engage.

4.3.1.4. Responsibilities within city-civil society interactions at the implementation and management phases. Across both the implementation and management phases, a shared barrier observed was the lack of formally regulated and assigned rules for city-civil society interactions. This was particularly evident in responsibilities associated with phase-specific tasks, such as soil preparation, mowing and other related activities.

In hierarchical modes, challenges were also highlighted in the Baumkirchen Mitte Landscape Park unit. City representatives cited health, safety, and insurance issues - such as liability in case of accidents, as legally complex and difficult to resolve. The city representative reflected that when maintenance responsibilities would be handed over to civil society, questions of accountability arose, creating significant uncertainty regarding who would be held responsible if something went wrong. These barriers were compounded by the need to address multiple interrelated factors, such as providing insurance and compliance with existing regulations, which further make the civil society participation challenging to realise.

In non-hierarchical modes, a similar barrier was evident in the Colourful Ribbons initiative (non-hierarchical). According to the unit initiator, the city administration generally has difficulty adapting to activities related to the implementation and management of UGI that differ from its established processes. This was described as being associated with a reluctance to take responsibility for alternative approaches, particularly if there is a possibility of failure. Moreover, the representative of the environmental organisation, in charge of civil society engagement emphasized the difficulties of involving citizens in tasks like mowing green areas, given the associated risks and potential health hazards. Consequently, responsibilities for mowing remained with the city administration, resulting in the destruction of several ribbons.

In short, these cases showed that shared barriers and enablers for city-civil society interactions include the selection and execution of methods for city-civil society interaction (which played a dual role), technical knowledge ownership, the city administration's motivation, and rules about responsibilities. Inappropriate methods and centralized technical knowledge hinder interactions, while appropriate methods and clear communication enhance them. Motivation and formally regulated responsibilities also play crucial roles in effective city-civil society interactions.

5. Discussion

This study aligns with the broader academic discourse calling for governance systems that are collaborative, adaptive, inclusive, and capable of integrating governmental and non-governmental actors into decision-making processes to address the complexity of UGI development into urban areas [31,47,66,67]. By applying the Environmental Governance Framework to seven UGI interventions in Munich, the study provides three main insights that improve the understanding of governance dynamics and what shapes actors' arrangements.

5.1. Shifts in governance modes throughout UGI development phases

Utilising the EGF helped us to categorise the units based on the governance mode types and identify their shifts across development phases, revealing the diversity and dynamic nature of co-existing modes over time (Table 3). These findings align with the mosaic governance concept, which acknowledges the plurality of governance approaches and emphasizes their desirable coexistence [14]. This study extends the mosaic governance concept by a temporal dimension as findings demonstrate that governance modes are dynamic, shifting in response to contextual factors and evolving needs.

For example, the 3500 Trees Program transitioned from a non-hierarchical mode during idea development, where civil society's local knowledge was crucial, to a hierarchical mode in later phases as the city administration gained the resources and expertise needed. This shift resulted from a change in civil society's role, from active knowledge providers to no longer being involved in the process. This observation supports Driessen et al. [48], who suggest that shifts in governance mode are closely connected with changes in actor's roles and power dynamics. The research also provides insights into the potential triggers for such changes, illustrating that the dependence of city

administrations on civil society's local knowledge - an intangible resource linked to power bases, may significantly influence power dynamics and enable temporary forms of collaborative governance.

Driessen et al., [48] and Arnouts, Zouwen and Arts [11] highlighted the inherent dynamic of governance modes, emphasising that changes within one governance element can affect others, resulting in new actor constellations or the renewal of existing arrangements [11]. These dynamics underscore the need for adaptive strategies to address shifting governance conditions, with an emphasis on resolving barriers shared across different governance modes.

5.2. Spatial dimension of environmental governance framework (EGF)

With the help of EGF, we revealed specific spatial factors influencing the actor's interactions. While previous studies have highlighted the importance of spatial and contextual factors - such as UGI type, location, size, and function [e.g., [40,51]], our study showed that certain spatial factors can play a dual role as a barrier and as an enabler.

For instance, during the management phase in non-hierarchical modes, a small UGI on public land can enable civil society engagement because its maintenance is feasible for citizens (Colourful Ribbons unit). In contrast, the same small UGI on private land may be independently managed by the owner, who has the necessary expertise for its maintenance (Private front garden unit). This highlights the need to consider the spatial factors in connection to the power base - specifically land ownership and the cumulative impact of expert knowledge. Overall, our findings demonstrate that spatial characteristics are active shapers of governance dynamics, interconnected with other governance factors.

The dynamic interplay of governance elements aligns with a systems thinking approach, which emphasizes the interlinkages between system elements and their evolution over time. Ansell and Gash [7] argued that actor arrangements are shaped by the coexistence of diverse factors rather than singular elements. Similarly, Eisenack et al., [68] highlighted the need to understand underlying conditions and interconnectedness of these elements to address governance challenges effectively.

5.3. Shared governance factors as leverage points

The final key finding provides insights into how city-civil society interactions can be strengthened through strategically addressing barriers within such dynamic interplay of governance factors. This study highlights that targeting shared barriers has a more systemic impact, as these barriers are influencing both hierarchical and non-hierarchical governance modes. Overcoming them first can serve as leverage points for broader governance system transformation [69]. Moreover, the study showed that different shared barriers emerge at different UGI development phases, meaning that leverage points may also shift over time, calling for governance strategies that remain adaptive [70,71].

Among the shared barriers identified in this study - limited communication, knowledge ownership issues, a decline in personal motivation within the city administration, and ambiguous responsibilities - each interacts with mode-specific and/or unit-specific barriers and enablers, jointly shaping the city-civil society collaborative dynamics.

Shared barrier and enabler: The selection and execution of methods for city-civil society interactions.

Inappropriately chosen methods of communication and inadequate information dissemination by the city administration have been identified as a shared barrier, with respondents noting that civil society actors often remained unaware of collaborative opportunities, potentially resulting in reduced involvement.

This shared-barrier reflected an interplay of influential governance factors: the hierarchical-mode-specific barrier of incoherence in existing formal rules of information distribution (Artur Kutscher Square unit), and the non-hierarchical-unit-specific barrier of limited personal

motivation from civil society to proactively seek for collaboration (Private Front Garden unit). While the barriers identified in one unit were not named in others, certain assumptions can be made. In the case of Artur Kutscher Square, if local civil society had been more proactive and interested in participating, their involvement could have been possible, as opportunities for collaboration were available even if insufficiently communicated. Similarly, in the Private Front Garden unit, the lack of coherence in formal rules governing interactions hindered engagement by leaving specific groups of private landowners unrepresented and without adequate information about potential collaboration opportunities.

On the one hand, the way city administrations communicate with civil society can be constrained by internal institutional limitations, the established organisational structure, and culture [1]. On the other hand, inadequate information dissemination can be interpreted as a case of power asymmetries. Inappropriate tool selection can become an instrument for remaining in control and making the decisions by the city administration legitimate, rather than striving towards truly democratic participation.

Beyond highlighting the need for tailoring communication to different actor needs [35], this research demonstrates that selecting tools aligned with the specific objectives of city-civil society interactions can act as an enabler for enhanced collaboration. For example, in the Oaks of the World unit, a shared event provided a platform to introduce city representatives to citizens, fostering direct interaction. Similarly, in the Artur Kutscher Square unit, the use of a future square visualization was perceived to help clarify the design concept for civil society, supporting better understanding.

It became evident that internal processes that are currently established within the city administration, particularly how decisions are made about the communication tools and methods selected, influence interactions with civil society. However, as the findings of this study and broader literature show, being able to build long-term, meaningful interactions requires more than just appropriately chosen tools. It depends on mutual trust, a shared commitment to common UGI goals, and personal motivation of both civil society and city administrations [7].

Shared barrier: City administration's motivation to interact with civil society.

The limited motivation of the city administration to engage with civil society, while identified as a shared barrier at the implementation phase, can be interpreted as an outcome-barrier resulting from the influence of broader governance barriers.

The non-hierarchical mode (Colourful Ribbons) revealed the city administration's hesitance to involve civil society in certain tasks, such as mowing. This hesitancy was connected with a lack of trust due to potential risks that can result from uncertainty. Thus there is an indication that trust is an important factor in maintaining commitment within collaborative efforts and shaping motivation [7]. In this case, these risks were perceived rather than clearly defined, resulting in health and safety concerns, or infrastructure damage - issues for which city administration potentially would not want to be liable. Thus, instead of finding ways to address this risk through formal agreements, the decision was not to engage civil society in such tasks.

This significance of trust was further observed within another non-hierarchical mode (Oaks of the World), where mutual trust between city and civil society actors, established from the beginning, served as a crucial precondition for long-term interaction, supported by clearly defined and transparent responsibilities across actors (see shared barrier: Responsibilities across actors in city-civil society interactions).

In the context of the hierarchical mode (3500 Trees Program), the lack of motivation within the city administration to engage civil society was explained by the need for internal institutional change in terms of additional resources and prolonged procedures required. In this case, these procedural concerns were related to municipal risk management, and the preference was given to minimize the internal institutional change and maintain control and decision-making power over the

processes rather than find ways for governance arrangements where the responsibilities are shared with civil society. As seen, the city-civil society interactions can be hindered by institutional reluctance to take on additional risk.

It is important to acknowledge that both units presenting this shared barrier are located on public land, which is considered a fundamental basis of power asymmetry due to the decision-making power held by the city administration to determine who is allowed to take part in the processes of public space development [72].

The institutional reluctance can be linked with the lack of clearly established legitimacy and well-defined mandates, which Pugel et al. [73] identify as key for securing government commitment to collaborative approaches, thus emphasizing the importance of established processes and capacities within the city administration. This issue is further linked to the existing formal rules of interaction between city administrations and civil society, a barrier consistently observed across all units in this study, though its presence varied across different development phases.

As Sarabi et al. [33] highlighted, addressing the lacking motivation barrier requires a clear understanding of the motivations driving all actors involved and identifying the benefits and potential risks provided by various UGI's. Such an approach allows for aligning the interests of diverse stakeholders and highlighting the mutual advantages of collaboration.

Shared barrier: Technical knowledge ownership.

Units demonstrated that city administration often owns expert knowledge, including information about plant types, planting methods, and underground utility infrastructure. However, internalizing this knowledge can be a barrier to interactions, as decision-makers may perceive civil society input as redundant or resource-intensive to integrate [31]. Moreover, technical knowledge is often connected with legal and procedural responsibility [74]. Thus, the city administration can control this knowledge to manage risk and keep liability instead of taking responsibility for the potential risk in case failure leads to public or legal proceedings.

When actors have sufficient expertise to accomplish their objectives independently, they are more likely to operate autonomously, reducing the likelihood of engaging with others. This dynamic was evident in hierarchical (3500 Tree Program) and non-hierarchical (Colourful Ribbons) governance units, where the sufficiency of internal technical knowledge reduced civil society involvement during the implementation phase of UGI.

As it was illustrated the local knowledge can be an example of power asymmetries triggering the shifts in governance modes, so can be the expert and technical knowledge.

When city administrations perceive themselves as self-sufficient and operate independently, this creates a power asymmetry that can influence their motivation to engage civil society. To address this asymmetry, the importance of interdependence among actors is acknowledged [7]. Such balance can potentially be achieved when city administrations recognize their need for resources from civil society. Even when the city administration has technical expertise, it often faces increasingly scarce resources for long-term UGI maintenance. In this context, engagement of civil society in monitoring and maintenance tasks can help rebalance power dynamics and shift actor arrangements back towards a more collaborative mode, as it was shown in the Oaks of World unit.

The findings demonstrate that internalized knowledge can potentially reduce interdependence while reinforcing associated risks, which may, in turn, diminish the city administration's motivation to collaborate - another shared barrier identified in this study. This observation highlights that knowledge, responsibilities, and risks are coming along in the co-implementation governance processes, and their allocation should be prioritized if the city plans to engage city-civil society in UGI implementation.

While previous research has identified the knowledge-related barriers as particularly impactful, as addressing them can lead to broader

systemic change [33], this study further demonstrates that its influence is most significant during the implementation phase.

To overcome the barrier of internalized knowledge, city administration and the third sector should acknowledge civil society's right and interest in participation, as well as their access to land and resources [75], even when they can implement UGI autonomously.

In this case, legitimacy, which is "the acceptability of the position of the 'governing' over the 'governed'," [76] is closely linked with data governance, transparent decision making and keeping civil society informed. While not entirely giving access to the technical information that may be sensitive or under data protection regulations, actors could explore intermediate approaches, such as decision explanation or provision of rationale behind planting strategies, to reduce opacity. That calls for the selection of proper methods for information distribution and civil society raising awareness (see shared barrier: The selection and execution of methods for city-civil society interactions).

Shared barrier: Responsibilities across actors in city-civil society interactions.

Ambiguity regarding responsibilities and insurance during the implementation and maintenance of UGI is a shared barrier observed within interventions on public and private land.

In the hierarchical mode, as exemplified by the Baumkirchen Mitte Landscape Park, decision-making responsibilities shifted between the real estate actor, city departments and the district committee. While the district committee was initially responsible for informing civil society about future plans, key decisions about park development were made between the real estate company and city administration, which operated without citizen input. The non-hierarchical mode, presented by the Colourful Ribbons, further illustrated how the interventions that differ from the established processes needing the redistribution of responsibilities from governmental to non-governmental actors may contribute to complex bureaucratic procedures [77,78].

This procedural complexity can be associated with liability questions regarding who is responsible in case of an accident or unexpected damage. This issue can be considered as a form of power asymmetry where city administration controls how responsibilities are assigned and avoids shared responsibility through the absence of formal agreements. As demonstrated in the Colourful Ribbons unit, such ambiguity can result in UGI damage. Additionally, it can be linked to the shared barrier of city administrations' limited motivation to engage with civil society, reflecting a deeper structural power imbalance. The city administration has the authority to influence and shape rules governing UGI interventions on public land, which can further complicate governance processes.

More broadly, ambiguity in responsibilities often stems from uncertainties within governmental structures, where responsibilities are often fragmented across different jurisdictions and administrative levels [23].

This study highlights the importance of clarifying actor responsibilities during the implementation phase, demonstrating that unresolved ambiguities persist into the management phase may hinder long-term city-civil society interactions.

Creating formal and informal agreements, such as voluntary agreements or legal guidelines, while considering the associated risks could help reduce ambiguity in the development process and improve the power imbalance [24].

These findings underscore the need for clear frameworks within the city administration, specifying who is involved, their roles, how communication and decision-making will be coordinated, and potential risks addressed across phases. Ensuring effective coordination and communication among actors must be supported by trust between city administrations and civil society, which serves as a foundation for sustained motivation and commitment [7].

5.4. Reflection on methodology

Although the Environmental Governance Framework was instrumental in identifying barriers and enablers, its application revealed challenges in addressing overlaps among governance features during data analysis. One of the key difficulties was distinguishing between certain features due to limited causal understanding, which in some cases led to governance elements being categorised under multiple features, potentially influencing the final list of identified barriers and enablers. This limitation suggests that refining the framework by redistributing overlapping features into independent categories with subcategories (e.g., knowledge) could improve analytical clarity.

While this study did not observe a clear interconnection between shifts in shared barriers across different phases, primarily due to only a single unit exemplifying a shift from non-hierarchical to hierarchical mode, such interconnections may occur when analysing a broader number of units that better represent the changing nature of governance modes. Therefore, to better understand the interconnection between shared barriers and development phases, future research could focus on units that explicitly illustrate transitions between hierarchical and non-hierarchical modes. Additionally, selecting units with comparable spatial and functional characteristics (e.g., size, type and purpose of UGI) across different contexts, could help clarify whether shared barriers remain consistent or vary according to UGI type and context. This focus on alignment is particularly significant, as the research on structural barriers and enablers for nature-based solutions by Dorst et al. [6], highlighted that influencing conditions can vary across countries, further emphasizing the need for context-sensitive analysis, thereby addressing a key limitation of this research.

Moreover, as this study aims to contribute to generalization of theoretical insights [56] into UGI governance dynamics based on findings from diverse governance modes - not UGI's initiating actor, UGI interventions initiated by the private sector and grassroots groups were underrepresented in the selection.

However, despite these limitations, the methodology was suitable for the objectives of this study. The results provide valuable insights into systemic issues, by identifying specific shared barriers and enablers that shape city-civil society interactions. Furthermore, the results underscore how these shared barriers and enablers are influenced by other governance factors and highlight how established institutional processes and existing capacities within the city administration shape collaborative dynamics with civil society. This offers a foundation for future research aimed at deepening an understanding of municipal capacities and internal processes in urban green infrastructure governance.

6. Conclusion

Recognizing the significant role of city-civil society interactions in both hierarchical and non-hierarchical governance modes, this study contributes to the research by highlighting the importance of distinguishing between shared and mode-specific barriers and enablers. This distinction is particularly significant given the revealed dynamic nature of governance modes throughout the UGI development process. Due to observed interconnections between shared, mode-specific and unit-specific governance factors, this study demonstrates that shared barriers cannot be addressed in isolation.

This research identifies four shared factors that act as either barriers or enablers to city-civil society interactions across different phases: limited information distribution during idea development, which plays a dual role as both a barrier and an enabler, knowledge ownership during implementation, and ambiguity in responsibilities spanning both implementation and management phases.

The findings reveal several key insights. While some shared barriers change depending on the UGI development phase, others persist consistently across multiple phases, indicating their impact over time. Additionally, certain shared barriers influence one another within the

same phase, requiring prioritization at the phase of influence. Furthermore, governance factors can act as both barriers and enablers, depending on the context in which they operate. While shared barriers are present across governance modes, their underlying causes may differ, necessitating context-specific approaches.

For practitioners aiming to improve city-civil society interactions at each UGI development phase, it is important to enhance the understanding of commonalities and differences between barriers and enablers across governance modes. Solutions derived based on generalised barriers risk addressing issues relevant to one governance mode, overlooking those affecting others.

Developing effective solutions to overcome barriers requires a systems thinking approach, which enables a holistic understanding of the interconnections between hindering and enabling governance factors. Actions to improve interactions must be informed by an analysis of the underlying causes of shared barriers, ensuring that efforts focus not only on overcoming obstacles but also on reinforcing enablers that foster long-term collaboration.

To build on these insights, future research should prioritise learning from cities with comparable governance contexts to understand how they address similar issues. Such comparative studies could identify the specific conditions necessary to overcome shared barriers and leverage shared enablers, providing insights on how governance dynamics can foster more effective and inclusive governance of urban green infrastructure.

NBS Impacts and Implications

- **Social:** The research examines how urban green infrastructure (UGI) governance fosters inclusivity in decision-making and enhances transparency in governance processes. It underscores the importance of city-civil society collaboration, advocating for co-design, co-implementation, and co-management as essential mechanisms for sustaining long-term actor engagement in urban green space development.
- **Environmental:** The paper centres on the co-governance of UGI as a means to mitigate biodiversity loss, enhance health and well-being, and support climate adaptation, among other advantages. By identifying key barriers and proposing collaborative strategies, it addresses fundamental challenges to UGI implementation, contributing to healthier, more biodiverse, and nature-inclusive urban environments.
- **Economic:** N/A

CRedit authorship contribution statement

Elizaveta Fakirova: Writing – review & editing, Writing – original draft, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Martina van Lierop:** Writing – review & editing, Validation, Methodology, Conceptualization. **Hade Dorst:** Writing – review & editing, Validation, Conceptualization. **Stephan Pauleit:** Writing – review & editing, Validation, Supervision, Methodology, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Prof. Stephan Pauleit reports financial support was provided by German Research Foundation. 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.

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Supplementary materials

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Data availability

Data will be made available on request.

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