



Understanding collaborative governance of biodiversity-inclusive urban planning: Methodological approach and benchmarking results for urban nature plans in 10 European cities

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Abstract

The EU Biodiversity Strategy for 2030 aims to restore Europe's biodiversity for the benefit of people, climate and the planet. Target 14 mandates that cities with at least 20,000 inhabitants should develop an ambitious urban greening plan. The Kunming-Montreal Global Biodiversity Framework promotes biodiversity-inclusive urban planning through a stronger governance approach, that includes people and public participation across all levels and sectors. Recent policies encourage cities to develop urban greening plans, together with mechanisms for monitoring the progress toward EU and global biodiversity targets. This research proposes quality criteria against which EU cities could be evaluated while establishing ambitious urban nature plans. An analytical framework was developed consisting of 30 criteria across six macro categories: urban biodiversity goals and targets, collaborative governance, institutional support, public participation, financing mechanisms, and monitoring and evaluation aspects. The framework was applied to assess urban green plans for a sample of ten cities with existing urban green or nature plan for at least 3 years. Policy and research experts were consulted on the selected criteria and the cities' results. It emerges that public participation and collaborative governance are rarely considered integral part from the beginning of established plans except in a few cities despite EU guidelines advocating for adoption of co-creation approaches. Only 4 out of the 10 cities performed well across all the 6 macro categories. Moreover, 7 out of the 10 cities showed evidence on a lack of monitoring and evaluation, and financial mechanisms to promote urban greening and collaborative governance of biodiversity. These results can help local authorities to build ambitious, yet robust, urban greening plans and support national/regional authorities to monitor progress toward EU and global biodiversity policies.

Keywords Urban biodiversity · Collaborative governance · Policymaking · Urban nature plans · Urban green plans · Nature-based solutions

Introduction

Global trends and scenarios for urban biodiversity loss have shown that land-use and climate change effects combined have and will continue to cause biodiversity to decline

(Pereira et al. 2024). This holds true specifically for cities in the northern and western regions of Europe (Perrelet et al. 2024). As an EU policy address to this worrying situation, target 14 of the EU Biodiversity Strategy 2030¹ (EU BDS) specifies that cities with at least 20,000 inhabitants should have an ambitious Urban Greening Plan (UGP) or Urban Nature plan (UNP).² Efforts are underway at all policy-making levels, the Commission published guidance to assist municipalities develop UGP³ and set up an online urban

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¹ European Commission, 2020, EU Biodiversity Strategy for 2030 (COM/2020/380 final), <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52020DC0380>.

² Both terminologies are used interchangeably https://environment.ec.europa.eu/topics/urban-environment/urban-nature-platform_en

³ <https://circabc.europa.eu/ui/group/3f466d71-92a7-49eb-9c63-6cb0fadf29dc/library/6d3d8199-38cf-443b-b4ec-3326263db9e3/details?download=true>

greening platform and provide information for cities. Local authorities should ensure that urban planning processes systematically incorporate green infrastructure thinking and nature-based solutions. The Green City Accord framework⁴ emphasizes that cities should make progress in improving the quality of green areas and restoring urban ecosystems to conserve and enhance urban biodiversity.

Internationally, target 12⁵ of the Kunming-Montreal Global Biodiversity framework (GBF) calls for biodiversity-inclusive urban planning approaches and highlights the role of urban planning in supporting the technical and political process of managing the inclusive use of urban spaces (CBD 2022). The significance of urban biodiversity within this framework investigates who are the main actor's collaboration, along with their roles and responsibilities within the planning decisions devoted to sub-national, regional, city and municipal governments; and what specific implications are affecting by implementing green and blue spaces. Those processes should focus on the alignment between public and private domain agendas and economic activities to ensure the projects financial stability and sustainability.

Recent biodiversity policy developments come on top of climate policy commitments such as the targets set by the EU to reach climate neutrality. In this context, several researchers have started investigating the spatial implications of the UGPs (or UNPs) adopted by the cities (Elander et al. 2005; Galan et al. 2023; Costadone and Vierikko 2023; Vandecasteele 2024). Monitoring progress toward UGP-related targets in environmental policies is challenging because the standards for plans and objectives related to urban green and urban nature plans are idiosyncratic and often inconsistent in their structure (Maney et al. 2024). While reflecting on how these plans could be collected and evaluated against a standardized set of criteria, it was noted that there are no specific formats in which these plans are established or organized systematically (Rega-Brodsky et al. 2022; Cardona Santos et al. 2023). Additionally, many plans are in the original languages of their countries, which complicates collecting in one unique depository for all plans to be steadily analysed.

Urban biodiversity research and practice look at people's interest in how to become involved in spatial distribution of nature in cities (Nilon et al. 2017; Nilon 2023). Nonetheless, few studies exist on how to properly design and implement urban biodiversity actions in collaboration with citizens in a way that matches their needs and aspirations locally. This deficiency is in part due to the lack of prioritization of biodiversity in urban areas due to beliefs that biodiversity rather belongs to natural and protected areas. In addition, general

knowledge on urban biodiversity does not often include the citizen engagement as part of the implementation process in cities. Similarly, research shows that there is few literature and similar experiences in which citizens are part of the driving force in the establishment of UNP in their cities to enhance urban biodiversity (Haase and Dushkova 2024) while there are more examples for local climate plans (LCP), (Reckien et al. 2018, 2023; Ulpiani et al. 2024; Battisti et al. 2024).

Latest research is increasingly oriented on stimulating an interdisciplinary approach to understanding beyond silos in urban planning systems that address debates around improving cities resilience and capacities for climate change (Di Marino et al. 2023) and at the same time increasing green and blue spaces within cities to contribute to better human well-being. While clearly set from several frameworks, the overarching target 14⁶ from GBF highlights opportunities for nature-based solutions at different scales to better up urban planning processes towards increasing biodiversity-inclusivity. Nonetheless, no clear monitoring mechanisms are in place to ensure stakeholder diversity and their affecting/affected roles within the planning for urban biodiversity actions (Pierce et al. 2020; Wilk et al. 2021; Moersberger et al. 2024).

Defining collaborative governance in the context of urban biodiversity

Collaborative governance is extensively defined as the functions and structures of policy decision-making and administration that involve public beneficially across the limitations of public institutions (Zia ud din et al. 2023). Ansell and Gash (2008) and Emerson and Nabatchi (2015) examined collaborative governance regimes and drivers and identified the role of networks, partnerships and institutions to be carefully guiding the process through the use of different tools to help solve the wicked problems of environmental policies (Hofstad et al. 2022; Øjvind Nielsen et al. 2024) such as in this case the EU BDS. In this research article, a specific angle of analysis related to collaborative governance in urban planning and how the different mechanisms and instruments that are utilised in these UNPs are adopted to foster their implementation in an inclusive manner with citizens and local stakeholders, is explicitly undertaken, see (Mahmoud 2024)

This gap on *biodiversity-inclusive urban planning* is exactly where this research framework falls with its objective and its originality. On one hand, we systematically analyse existing UNPs from a sample of cities and benchmark their successful implementation for an ambitious plan according to the EU BDS 2030. On the other hand, we unpack the collaborative governance, institutional support and commitment to implementation mechanisms as well as public participation methods through which cities can strengthen their UNPs actualisation according to the Kunming Montreal GBF (CBD 2022). For this double angle, the selected criteria focused on

⁴ https://environment.ec.europa.eu/topics/urban-environment/green-city-accord/monitoring-framework_en

⁵ <https://www.cbd.int/gbf/targets/12>

⁶ <https://www.cbd.int/gbf/targets/14>

the following categories 1) urban governance and commitment to implementation, 2) institutional support and policy integration, and 3) public participation and collaborative governance mechanism; that aims to fill the gap of both strategies.

Based on these notions, the gaps that were observed are related to what could be the possible manner in which cities could establish their urban green plans; for this purpose, we propose twofold objectives in this research. At first, we attempt structuring a “standardized” set of criteria against which several UNPs of cities could be analysed. In the initial part of the criteria, a specific attention is given to the urban biodiversity goals, targets, and actions within the plans; that set of criteria aims to mainly understand how cities could include “*measures to create biodiverse and accessible urban forests, parks and gardens; urban farms; green roofs and walls; treelined streets; urban meadows; and urban hedges.*” (European Commission et al. 2022). Secondly, by examining 10 cities as a sample for the evaluation of the selected criteria; we identify main barriers and challenges as well as success factors through which cities can rework their UGP toward better policy-making and inclusive urban biodiversity planning. Similarly, the research presented in this contribution is framed within the activity of the National Biodiversity Future Center (NBFC) [2022–25], one of the five national research centers funded by the Italian Recovery and Resilience Plan within the NextGenerationEU program, aimed at aggregating and sustaining the scientific research on biodiversity in the different national territorial contexts. In particular, this article is part of the similar research conducted by Spoke 5 of the NBFC dedicated to investigating biodiversity dynamics in cities and urban areas on the Italian national territorial level, represented by the first author.

The ultimate aim of this research is to identify key policy takeaways for cities to establish UNP that are collaboratively governed as well as the barriers or enablers to help cities that currently lack UNP. For this, examples from several cities were collected and analysed according to three research questions. In this research, the approach to collaborative governance focuses on understanding the interplay between local authorities planning for urban biodiversity actions and their actual commitment to implementing interventions with citizens, as well as a variety of stakeholders. Since the focus on the UNP, this research article then analyses further how the selected cities do implement the UGP guidance (European Commission et al. 2022) as part of the overall correspondence with the EU BDS 2030 target 14.

The article is divided into a methodological section, in which we identify the spatial sample (RQ1) and establish the possible criteria of the analysis (RQ2). In Section 3, we analyse the results coming from implementing the criteria on the cities across the identified sample (RQ3). Following in Sections 4 and 5, we elaborate on the discussions and conclusions with recommendations to policy making and future studies.

Methodology

The adopted methodology of this research was an iterative mixed methods approach, (Fig. 1). First, we sampled a few cities based on iterations from EU27 countries. Second, based on a combination of desk studies and workshops reviews with expert researchers and practitioners from different countries, we developed the final framework for analysis. Third, we analyse the 10 selected European cities based on the data collected from benchmarked databases and their urban green plans.

Research question 1: How to select a sample of cities (or FUA) that have existing UGP/UNP to analyse?

To answer the first question on the cities’ selection, we followed a twofold process. First, a spatial analysis was carried out in combining the Functional Urban Areas classification (FUA⁷) and the current cities with more than 100 k inhabitants⁸ according to the Eurostat database⁹ for the year 2021. Through GIS, a spatial join operation was performed to consolidate a dataset of cities that have more than 100 k inhabitants¹⁰ and the initially classified FUA (635 across EU27), which resulted in 729 units overall. This combination permitted to identify the cities delimitations that overlap with FUA boundaries because some cities had no plans at the local scale but at the metropolitan scale. The second step for the selection of cities and the evaluation criteria were developed in collaboration and iteration with a group of experts to identify the frontrunners of the urban greening plans through a snowballing technique in three separate workshops. Table 1a (Annex 2) presents several cities suggested by the experts; Table 2, lists the relative modifications and suggestions adopted from the experts’ iterations regarding the most adequate criteria for evaluating the UGP.

The first research question examined the existing databases for cities with UGP/UNP through various methods. First, we started by purposive snowballing sampling with seven experts from different institutions, in which 7 cities were benchmarked

⁷ FUA consist in a city and a commuting zone. At an initial level core cities are identified as urban centers (or high-density clusters) recognized as groups of grid cells with a population density of at least 1500 inhabitants/ km² and collectively a population of at least 50,000 inhabitants. Each core city is part of a polycentric commuting zone covering multiple cities (Zulian et al. 2022).

⁸ The selection of the cities with 100 K inhabitants is due to the large quantity of cities with 20 k inhabitants as a sample for one study, the authors then selected a larger scale to match the spatial data availability with the urban audit areas.

⁹ <https://ec.europa.eu/eurostat/web/cities/database>

¹⁰ Urban Audit data collection 2021. The cities are defined at several conceptual levels: the core city, using an administrative definition the Functional Urban Area/Large Urban Zone (FUA). Source: Eurostat <https://ec.europa.eu/eurostat/web/gisco/geodata>

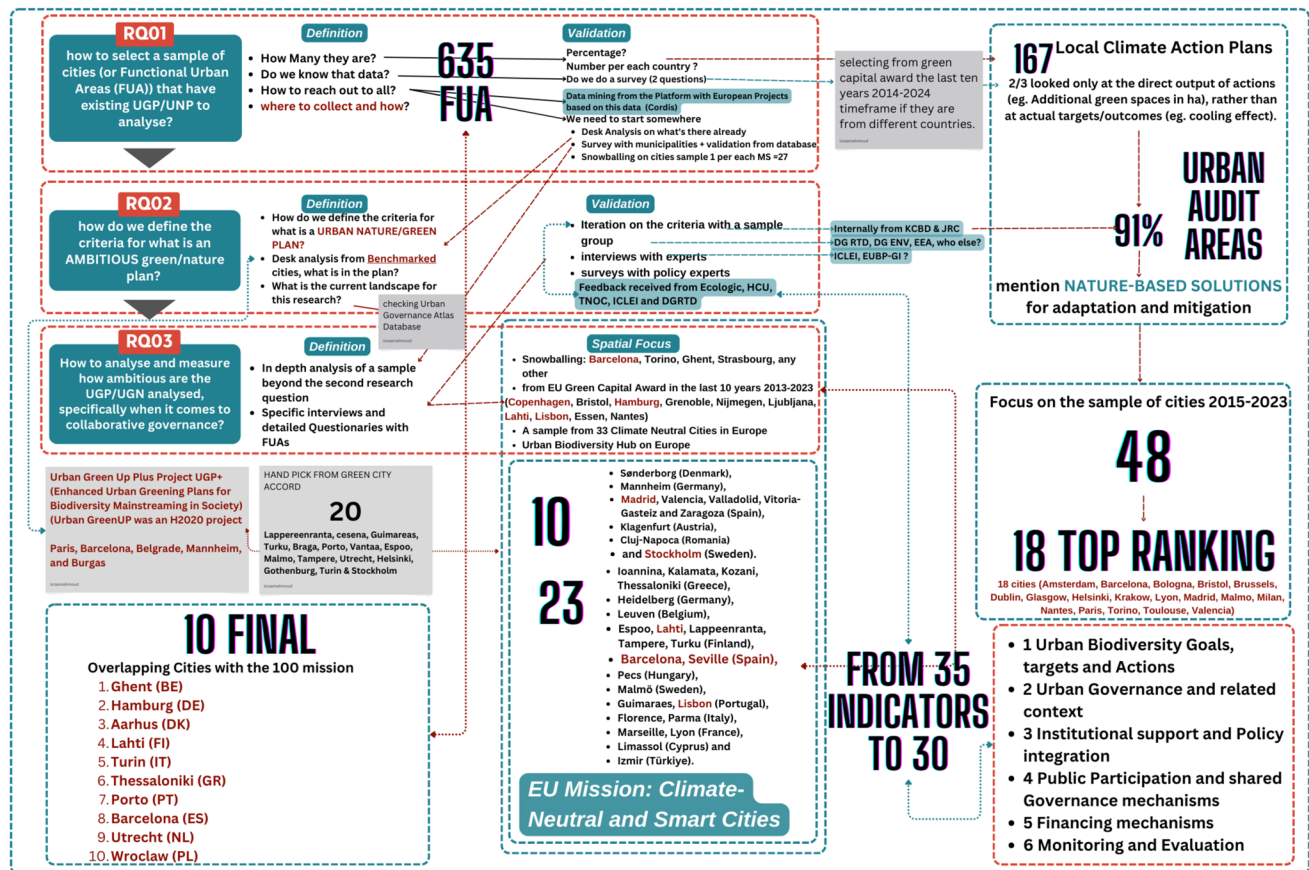


Fig. 1 Methodological approach and iterations adopted for the research methodology; source: the authors

(Barcelona, Torino, Ghent, Strasbourg, Utrecht, Hamburg and Paris). This snowballing also considered previous European funded Horizon 2020 and Horizon Europe projects that had tasked to establish UGP within leading or lighthouse cities (Soanes et al. 2023), (Annex 2, Table 1).

Second, a survey of existing databases from previous research established by the LCP initiative¹¹ led by (Reckien et al. 2023; Salvia et al. 2023; Buzási et al. 2024), adding other 18 cities to the selection (Amsterdam, Barcelona, Bologna, Bristol, Brussels, Dublin, Glasgow, Helsinki, Krakow, Lyon, Madrid, Malmö, Milan, Nantes, Paris, Torino, Toulouse, and Valencia). From these databases, two important aspects were further considered in the cities selection: (i) which cities had existing LCP for the last 5–7 years (from 2015 onward) and (ii) which cities from these had incorporated initiatives related to nature-based solutions and citizen engagement in their climate adaptation and mitigation plans.

Third, an overlap with the cities that have signed the green cities accord program¹² was refined based on (Costadone and

Vierikko 2023), highlighting an additional 15 cities. During cities selection, overlap with the EU Mission 100 cities mission was observed, especially for the 33 cities which committed to the climate neutrality mission (10 in 2023 and 23 in 2024), leading to the inclusion of 12 additional cities. From the urban Governance atlas,¹³ an additional 7 cities were selected by the filtering on the urban biodiversity topic and legislative, regulatory and strategic instruments of governance (Davis and Burgos 2022). Lastly, using the database of urban Biodiversity Hub,¹⁴ another 3 cities were added to the selection based on their participation to at least two initiatives related to urban biodiversity and nature-based solutions as in the database of their biodiversity plans (Pierce et al. 2020).

After removing the duplicates of cities and capital cities that had established an UGP/UNP since 2015, the overall set of pre-iterated cities amounted to 48 cities. We further excluded capital cities as they are usually displacing an enormous amount of money and effort to be included in European Union initiatives,

¹¹ <https://www.lcp-initiative.eu/>

¹² https://environment.ec.europa.eu/topics/urban-environment/green-city-accord_en

¹³ <https://interlace-hub.com/urban-governance-atlas>

¹⁴ <https://www.ubhub.org/map>

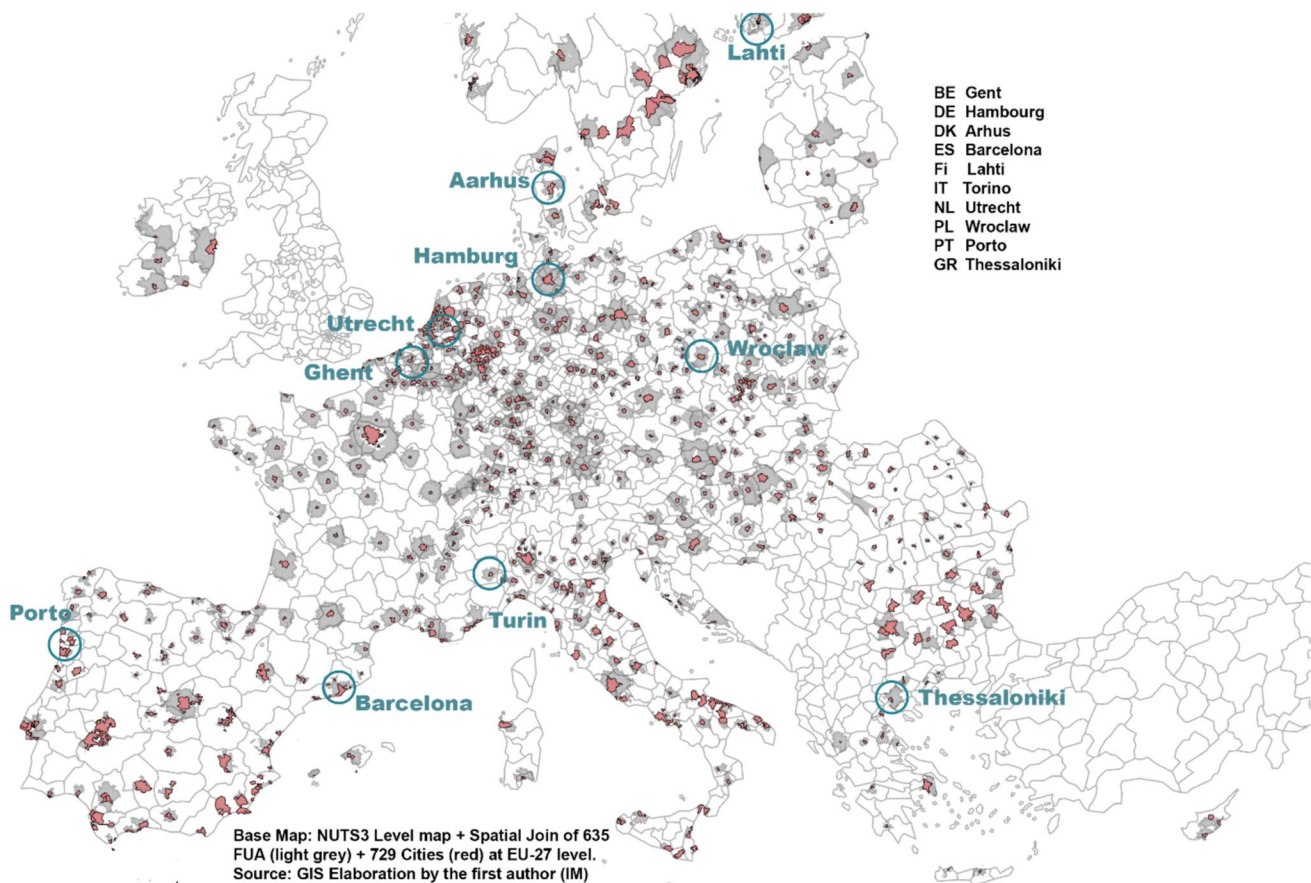


Fig. 2 Spatial distribution of the selected FUA (635 in grey) and cities with more than 100 k inhabitants (729 in red). The selected cities are highlighted in blue circles. The initial dataset for this benchmark also included 1) Nantes Metropolitan area that was then excluded due to impossibility to fetch the green plan documents; 2) Burgas that

did not have additional information on the plan except on its establishment; 3) Rijeka, the plan was not approved yet in 2024; and 4) Greater Valletta (Malta) that is the only city with more than 100 K in habitants as by the sample but then was eliminated since it is the Capital city. Source: elaborated by first author

are complex in terms of urban governance, evaluation matrices and spatial extents. In this article, only 10 cities (Fig. 2) are analysed as a first benchmark for the cities that have already issued an UGP/UNP in the last 5 years (Table 1b-annex 2).

Figure 2 depicts the spatial distribution of the joint data at the cities' boundaries (red) and FUA scales in northern Europe (grey), highlighting the different scales between Portugal, Spain, France on the left and Germany and Italy on the right. Several researchers have discussed this discrepancy in spatial scales reflecting inequalities in degree of urbanization and its distribution across Europe (Elander et al. 2005; Zulian et al. 2022). As Reichert (2024), illustrates cities and FUA (if incorporated) define metropolitan boundaries with a population of at least 250 k inhabitants which is currently the most adopted approach for defining the degree of urbanization that political boundaries do not reflect.

Research question 2: how do we define the criteria for what is an ambitious green/nature plan?

The selected criteria for developing the analytical framework for each city was performed through multiple iterations and validation steps. First, the researchers proposed macro categories relying on the research scope and topic composition of criteria¹⁵ from a literature review based on the benchmarked cities that focused on biodiversity and collaborative governance in urban planning (Table 1). This resulted in an original proposal (subsequently, adapted) of 5 categories comprising 35 criteria of analysis for the overall matrix: 1) biodiversity goals, targets, and actions (Nilon 2023); 2) urban governance and commitment to implementation (Wamsler 2015; Brink and Wamsler 2018; Zölch

¹⁵ https://www.timanalytics.eu/TimTechPublic/dashboard/index.jsp#/space/s_1713?ds=156451

Table 1 Definition of the topical composition of the criteria of analysis based on literature review. Source: the authors

Macro Category	Topic composition of the category	Criteria of analysis	Literature
Biodiversity goals, targets and actions	Established UGP/UNP officially adopted and recognized	Embeddedness of urban biodiversity and short/long term actions within the plan	(Nilon et al. 2017; Rega-Brodsky et al. 2022; Nilon 2023)
Urban Governance and commitment to implementation	Focus on the governance structure within the process of implementation and how stakeholders are involved In addition, observe the good practices of the plan actions (effective, sustainable, locally appropriate, potentially replicable, inclusive)	Policy instruments can be broadly understood as “adopted by the government as a way to implement their policies and influence the behaviour of citizens and businesses.”	(Pierce et al. 2020; Mahmoud 2024; Davis and Burgos 2022; Perrelet et al. 2024)
Institutional support and Policy integration	Focusing on enhancing policy impact through the adoption of actors’ roles within the process	Policy integration in both Vertical (across sectors) and Horizontal (across administrative levels)	(Berisha et al. 2023; Petzold et al. 2023; Vandecasteele 2024)
Public Participation and shared governance mechanisms	Participatory design refers to various methods of involving all stakeholders (e.g., employees, partners, citizens, end users) in the design process. It focuses on the processes and procedures of design to ensure that the outcomes meet the needs and functional requirements of the users. It can include co-creation – where citizens participate in designing or shaping strategic proposals, or even building the proposal	Focus on transparency and citizen engagement within the design process of the plan as well as the implementation of actions Possible co-benefits coming through implementing NBS actions; related to air quality, economic opportunities and social cohesion	(Mahmoud and Morello 2021; Pelsmakers et al. 2022; Øjvind Nielsen et al. 2024)
Financing mechanisms	Focusing on developing the sustainability of the planned urban biodiversity action through financing its plan in a longer-term plan	Possible integration of different financing mechanisms (public, private) and municipal participatory budgeting Blending incentives instruments (collaboration partnerships)	(Raymond et al. 2017; European Commission 2019)
Monitoring and Evaluation	Understanding existing frameworks of monitoring related to baseline data at the plan establishment. A focus on lessons learnt and achieving impacts from the actions	Establishing evaluation reporting mechanisms and indicators especially related to advancements from baseline targets and actions	(Armondi et al. 2023; Moersberger et al. 2024; Viti et al. 2024)

et al. 2018); 3) institutional support and policy integration, (Cotella et al. 2020; Petzold et al. 2023); 4) public participation and collaborative governance mechanisms (Mahmoud et al. 2021; Davis and Burgos 2022); 5) financing mechanisms and monitoring (Cortinovis et al. 2022).

The second step included some iteration of these categories between the co-authors and further addition of specific criteria related to the European Commission, Eurocities and ICLEI Guidance that was developed as part of EU BDS 2030 (European Commission et al. 2022).

Thirdly, the validation of criteria was undertaken with a group of experts from the KCBD, DG RTD, TNOC, Ecologic, and HCU.¹⁶ The KCBD and DG RTD teams are involved in policy design and the validation of urban nature plans monitoring, while Ecologic and HCU represent research bodies, and TNOC represents non-profit citizens association which makes this group balanced and well representative. In this last step, the categories were refined to split the financing mechanisms and monitoring macro areas into two distinct categories; and then include further micro criteria in these macro areas. Additional criteria were also included from the European urban Biodiversity index research by the EEA group as suggested by Ecologic experts (Ruf et al. 2018). The final analytical framework was established at the end of the iteration process consisting of 6 macro categories and 30 criteria (Table 2).

During this last validation phase, some selected cities were consulted through in-depth bilateral meetings and a sample of interviews with policy experts and city representatives from local municipalities about their urban nature plans' successes or failures. Some cities were asked to test the evaluation matrix themselves, providing in-depth analysis into how they assess their own success or failure in complying with their objectives set in the UNP.

Results

Research question 3: How to analyse and measure how ambitious are the UGP/UGN sampled, specifically when it comes to collaborative governance?

Each of the 10 sample cities has a scoreboard displaying the results from the analysis of criteria (Table 3, Annex3). Each city receives an overall evaluation horizontally for each criterion and an overall evaluation for the entire category in sum through a content-analysis of official planning documents. Each city receives a score (up to 120 points if scores 4 on all 30 criteria) for each vertical aspect of the framework based on the UGP/UNP itself and/or additional information

about urban biodiversity aspects. We adopted a Likert scale in the evaluation (0 = not mentioned in the plan- not elaborated, 1 = mentioned- not elaborated, 2 = mentioned—elaborated marginally or not monitored, 3 = major role in the plan- elaborated partially, 4 = major role in the plan- fully elaborated). Table 4 (Annex 3) summarizes the aspects highlighted by each city in macro categories as in Table 3, below.

The ambition level for each UGP/UNP were then analysed based on the framework and observations presented in Tables 3 below and in Tables, 4 and 5 (Annex 3). Cities' scores vary across criteria and categories (Fig. 3). The category with the highest score for all cities is "Urban biodiversity goals, targets and actions," with Hamburg scoring the highest (28/32). Institutional support and policy integration are among the categories in which almost all cities (9/10) perform well; mainly because most of the adopted UGP/UNP are supported by their municipal authorities. An underpinned observation in all plans is that the ones updated after 2020 or 2021 have explicit reference to NBS in correspondence with target 14 of the EU BDS. In contrast, UGPs written before the last 3 years have no explicit reference as such, except in the case of Thessaloniki (2017, p. 141) which highlights the intervention types and their responsible stakeholders.

The categories with the lowest scores are 5) financing mechanisms and 6) monitoring and evaluation, except Lahti which performed relatively well (16 points in financing and 15 in monitoring). Overall, our evaluation reveals that cities struggle in establishing clear financial pathways destined for nature and biodiversity without compromising other public sectors. The same holds true in monitoring and evaluation of actions category, except for protected areas. It is by far the only category that revealed no commitment to one standard set of indicators across all cities or possible self-assessment metrics except in Lahti. Even though Porto (2020)—scored lowest in both categories 5 and 6 – it manifests a strong environmental strategy in terms of overall planning that incorporates nature-based solutions and educational programs in school but lacks nevertheless an actual timeline for the overall plan.

Discussion

The discussion is divided into two parts: the first one considers common observations of urban biodiversity and governance, while the second one focuses on the ambition level of the plans and provides detailed results for each category of the evaluation framework composed of the 30 criteria.

Part I: General considerations

Regarding the thematic focus of some urban audit areas or functional urban areas, it is worth noting the difference between the variety of spatial forms and level of detail in

¹⁶ See nomenclature for experts' group in the supplementary material, P1.

Table 2 Final list of 30 criteria for the analysis agreed upon from literature, EU BDS and iterations with expert group. Source the authors

Macro Categories	Criteria of Analysis
Urban Biodiversity Goals, targets and Actions^	Established officially recognized and endorsed Urban Nature Plan (some plans are called green Infrastructure and Biodiversity)
	Relationship to multilateral environmental agreements, EU targets or explicit (or implicit) reference CBD targets 12 and 14 in GBF*
	Embeddedness of urban biodiversity (understanding of the concept, cross connections with several visions, explicit integration of urban biodiversity concerns and objectives in plan, and having a list of actions and/or objectives)
	Challenges addressed in the plan (ecological, social, soil health, water management, green space management, heat stress, social equity, connection to environmental education)
	Targeted areas such as urban and (peri)-urban areas: parks, semi natural areas, allotments, community gardens, urban green spaces connected to grey infrastructure
	Includes a strategic plan with an overarching vision, and an operational part (financial and investment plan, actions, timelines, indicators) , as well as a clear and specific budget with sources for the requisite funding identified. The delivery plan ideally should cover a period of 3-10 years. Longer term vision coupled with actions and milestones.
	Realistic timetable for implementation (Established short term actions within the plan)
	The Plan Includes actions related to improving accessibility to urban green and blue areas (% of population that can reach within 10-15 min walking distance green or blue urban areas)
Urban Governance and commitment to implementation	Initiating Body Typology (types of actors involved and type of policy instrument and if envisaged any collaborative governance and citizen engagement actions)
	Stakeholders and local actors' involvement (An increased coordination and cooperation between the interested stakeholders to improve the effectiveness of Urban Biodiversity interventions)
	Governance models related working structure (instruments and mechanisms through which stakeholders manage the process such as managerial and working structures, internal formal or informal norms, configuration of sections and departments to better address and institutionalize aspects related to UGP)
	Multi-Actor (a diversity of stakeholders shares the responsibilities and results)
	Good practice actions oriented (effective, sustainable, locally appropriate, potentially replicable/upscaled, inclusive)
Institutional support and Policy integration/%	Multi-sectorial and multi-dimensional horizontal policy integration (across policy domains and sectors, as well as including, environmental, economic and social issues)
	Multi-level Vertical Policy integration (a transferable policy that works well across all administrative international/national/local governance levels)
	Interdepartmental consultation and intraorganizational collaboration with the relevant authorities (among different municipal departments and with private actors and citizens involvement toward breaking silos in governance)
	Political will the presence of and secure long-term political commitment
Public Participation and shared governance mechanisms#	A transparent and participatory co-creation approach. The Local Planning Authority should involve the relevant actors – citizens, academics, as well as representatives of civil society and economic actors including methods and timeline)
	Presence of actions (workshops, information sessions, etc.) linked to the involvement of the local community (voluntary groups, associations, committees, citizens, etc.) along part or all of the planning process (co-planning, co-design, co-implementation, co-monitoring of the plan / co-creation-co-production)
	Presence in the plan of education, communication and raising awareness actions (e.g. web portals, newsletters, raising awareness campaigns) of the local community on the benefits of urban biodiversity.
	Reference to shared governance tools/instruments (web portals, consultations, tables, framework agreements, collaboration agreements, etc.) for the implementation and monitoring of the actions envisaged by the plan.
	Reference to types of stakeholders involved in the process (PA, citizens, associations, businesses, etc.), phase of the participatory process in which they are involved, and level of representation of citizens.
	Integration of financial and investment plan in the temporal scope covered matching planned actions and targets (availability of financing proposed actions to be implemented, public and private funding, grants, philanthropy, pooling municipal budget)
Financing mechanisms	Sources of funding availability and diversity (public, corporate, NGOs funds, private, include presence of required financial expertise and capacity within municipal departments (or resources to commission them outside the departments)
	Integration of financial and investment plan (public and private funding, grants, philanthropy, pooling municipal budget) matching planned actions and targets
	Presence of blended finance and innovative incentive instruments (e.g. public-private(-people) partnerships, market-based instruments, etc.)
	Existing Monitoring framework in place related to plan baseline advancement (yes with/without indicators/no)
Monitoring and Evaluation	Possible continuous evaluation of performance across actions, targets and indicators (Previous Evaluation report, tools, indicators established, mainly on the plan itself and possible improvements) even if partial like every 2 years.
	Achieved Outcomes and Impacts / results from 1-2 years (if the plan is there for 3 years at least)
	Success factors and lessons learned from plan development (self-assessment by the municipality)

Table 2 (continued)

	Agreed upon by at least two groups of experts' reviewers blindly.
xx	Indicators suggested by the DG RTD
*	https://environment.ec.europa.eu/international-cooperation/multilateral-environmental-agreements-meas_en
	Reference to the Eurocities and ICLEI Guidance https://environment.ec.europa.eu/topics/urban-environment/urban-nature-platform_en
^	Criteria in Part selected from the Interlace project https://interlace-hub.com/urban-governance-atlas

Legend: To clearly distinguish between the three criteria from the 10 steps of the guidance and the ones suggested by the authors, they were highlighted in blue and introduced to the categories of a) the institutional support and policy integration, b) public participation and collaborative governance mechanisms. See + (Ruf et al. 2018), # (Mahmoud et al. 2021), % (Berisha et al. 2023)

each of the UGPs studied, see Annex 4. While some focus on the actions related to urban biodiversity and green or blue infrastructures themselves (macro category 1), like the plans of Turin, Ghent and Hamburg, other plans focused merely on the governance of the implementation process with the stakeholders and citizens in a greater detail (macro categories 3 and 4) such as the plan of Barcelona and Aarhus, see Fig. 4, for understanding the score of each city.

Overall, there is a large discrepancy between the expected details in the plans and the actual contents of the documents based on their genesis. For instance, in terms of nomenclature, only 3 plans (Barcelona, Hamburg and Ghent) had the exact nomination of Urban Nature plan.¹⁷ Several plans, such as the plans of Turin and Utrecht also still use the green infrastructure plan nomination to underpin green and blue infrastructure concepts and urban biodiversity actions (Lazarini et al. 2024). The only city that, besides developing a nature plan, has also established a detailed urban biodiversity plan is Hamburg, see (ICLEI and City of Hamburg 2020). The City of Lahti (2022) used the *Nature and Biodiversity* nomination as part of their Green Capital award 2021 plan which was translated from the Green Programme 2025.

In addition to the general challenges in finding and understanding the plans of some cities, one main problem was the language barrier; particularly for the cities that did not develop an English plan like Wrocław, another issue was the subdivision of the plan into multiple parts and several documents such seen in Utrecht, Hamburg and Lahti. Additionally, some plans are extensively detailed like Turin (176 pp) or Thessaloniki (153 pp), while others are medium length plans like Lahti (37 pp) or shorter like Hamburg (24 pp).

Accordingly, some cities are integrating UGP/UNP as part of overall spatial planning strategies for a future vision beyond 2030. For example, Utrecht 2040 plan combines greening plan with housing, mobility, social inclusion, and other priorities within the spatial strategy reflecting citizens

desire for a green living environment (City of Utrecht 2023). Similarly, Ghent's UGP/UNP falls within broader climate transition strategy encompassing energy efficiency, transport, food, circular economy and climate adaptation (Ghent 2020). The same method of incorporating the green plan within the larger master plan occurred in the City of Porto (2020) as part of the sustainable city strategy within the overall environmental index of the city. Thessaloniki was among the pioneering cities to incorporate the nature and biodiversity plan in the 2030 resilience plan.

One important enabler in these plans' success is effective communication and dissemination activities that rely majorly on citizens participation and engagement. Aarhus used non-conventional methods like podcasts to share the sub-national climate action plan just launched in April 2024. Lahti, after winning the Green Capital Award in 2021, launched a PR campaign to increase the visibility of the green programs by involving schools, social media, ice hockey team jerseys, and *Lahti Green Screen service*.¹⁸

The most common approach to collaborative governance in the analysed UNPs has shown a top-down model of public participation (Øjvind Nielsen et al. 2024) holistically, except in few cases where public participation occurred during the redaction of the plan itself such as City of Aarhus (2024). That is understandable because most of these plans (if not all of them) originate from municipal, regional or local authorities in where main responsibility falls on the local governmental bodies (or higher political level) to establish those plans and eventually implement them.

An important feature of these plans is their visual and graphical representation (Annex 4). All analysed plans included designed maps to show current and future urban green strategies and new areas. Importantly, some plans featured visual representations and monitoring indicators which

¹⁷ https://environment.ec.europa.eu/topics/urban-environment/urban-nature-platform_en

¹⁸ Giving nature a seat at the table: A service called Lahti Green Screen was launched in June 2021. It gave the City of Lahti's employees an opportunity to invite nature to participate in their Microsoft Teams meetings via a webcam placed in local forest. The idea was to give people working from home a virtual connection to nature that reinvigorate them and reduce stress during the COVID-19 pandemic.

Table 3 Heatmap displaying the summary of the 10 cities results across each of the 6 macro categories. Source: the authors

	Barcelona	Turin	Utrecht	Hamburg	Ghent	Aarhus	Lahti	Porto	Wroclaw	Thessaloniki
Macro Categories	Urban Nature Plan 2030	Piano Strategico Dell'infrastruttura Verde	Vision Green structure Utrecht 2030	Natürlich Hamburg !	2020-2025 Climate Plan	A Greener Aarhus	green area program 2013–2025	Environment quick guide	Climate Change Adaptation Plan 2030	Resilient Thessaloniki strategy 2030
Urban Biodiversity Goals, targets and Actions^	4	3	1	4	2	4	3	1	2	2
	3	2	3	4	2	4	3	3	3	2
	4	3	0	3	3	4	3	4	1	1
	3	3	3	2	3	3	2	3	4	3
	3	4	1	4	4	4	3	1	4	4
	4	4	1	4	4	2	2	2	4	4
	4	4	1	4	2	0	3	0	0	3
	2	0	1	3	2	3	2	2	0	1
Urban Governance and commitment to implementation	3	1	3	3	2	3	4	1	3	2
	4	2	3	1	3	3	3	1	1	2
	3	0	4	3	4	1	1	1	3	2
	4	2	3	3	4	4	4	1	1	3
	3	3	3	2	2	3	1	3	1	4
Institutional support and Policy integration%	3	2	2	3	2	4	4	4	3	4
	4	1	2	2	3	4	3	4	2	4
	4	4	2	2	4	2	3	2	2	3
	4	4	4	4	3	4	3	2	4	4
Public Participation and collaborative governance mechanisms #	4	4	4	2	4	4	4	0	2	4
	4	4	4	1	4	4	2	3	2	4
	4	4	3	1	4	4	4	4	4	4
	4	4	4	1	2	4	3	3	3	2
	3	4	2	2	3	4	2	2	2	1
Financing mechanisms	2	3	2	4	0	0	4	0	3	2
	1	2	2	4	0	1	4	0	2	4
	1	3	2	1	0	0	4	0	1	3
	2	2	3	1	0	1	4	0	2	2
Monitoring and Evaluation	3	0	4	4	4	1	4	0	4	3
	3	2	3	4	3	0	4	2	4	2
	4	1	3	3	2	2	3	1	3	1
	4	0	4	0	0	0	4	0	0	3
Total	98	75	77	79	75	77	93	50	70	83

In the previous table the criteria are

Data Points 1- 8=8×4=32 points

Data Points 9- 13=5×4=20 points

Data Points 14- 17=4×4=16 points

Data Points 18- 22=5×4=20 points

Data Points 23- 26=4×4=16 points

Data Points 27–30=4×4=16 points

Total score = 120 points

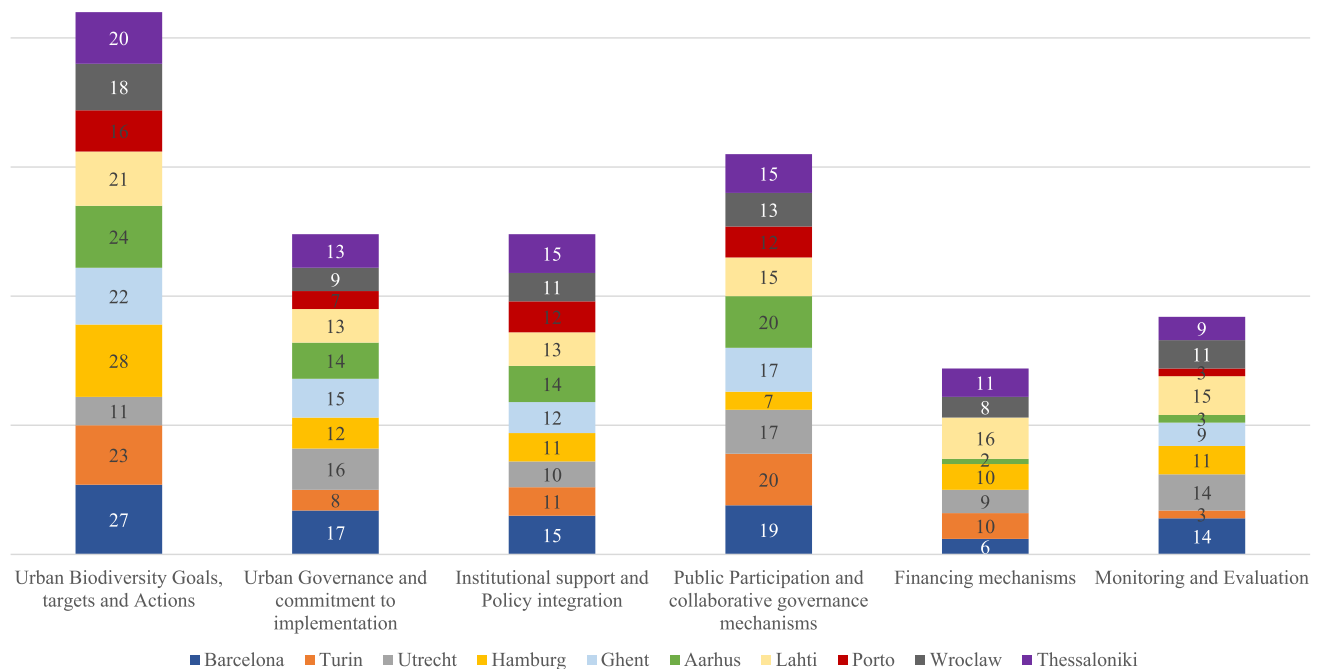


Fig. 3 Development of Macro Categories score by city. The bars represent the score for each category evaluation across the whole sample of cities. Source: the authors

show the expected improvement after the plan's implementation to reassure the public that their investment will yield tangible benefits. This approach was particularly distinguishable in some cities plans like Hamburg, Utrecht, Ghent and Aarhus.

Part II: Ambition levels of the plans by category based on the analytical framework

Urban biodiversity goals, targets and actions

This category was the most challenging to assess, both in terms of selecting sub-criteria or in terms of evaluation for each city UNP itself. The reason is that it incorporates several subtopics underneath it such as the embeddedness of urban biodiversity, challenges within the plan and targeted areas; as well as the specific actions related to implementation and operational aspects like timeline, visions and milestones (Nilon et al. 2017; Pierce et al. 2020; Rega-Brotsky et al. 2022).

For instance, Barcelona's plan incorporates a specific section on urban biodiversity and connection to citizens' health and well-being (Barcelona 2021, p. 58). In addition, it addresses the incorporation of biodiversity challenges into municipal regulations and technical documents of urban

planning, which helps avoid legal pitfalls related to citizen participation in urban greenery interventions (Action 16).

In contrast, Turin's plan lacks specific actions related to the requalification of some areas like Parco Michelotti,¹⁹ as prioritized focus related to increased accessibility without other reference to specific biodiversity targets, Comune di Torino (2020). Another challenge in Turin plan is the excessive subdivision of roles, responsibilities and areas of competences for implementation, which makes the plan fragmented in terms of monitoring of actions and hardly clear who is the responsible entity to account a clear governance process. One specific criterion in this category, which is the accessibility to green areas within 10 minutes was evaluated based on benchmarked cities in the database from EEA (2021) except for those without data, see Annex 3. The City of Thessaloniki (2017) for instance, established metrics related to accessibility to green spaces per resident across the entire city boundaries, which is noticeable for being under European average of 8-10m²; unlike Barcelona that established accessibility matrices at the neighbourhood scale.

¹⁹ <https://www.torinovivibile.it/aree-tematiche/riqualificazione-del-parco-michelotti/>

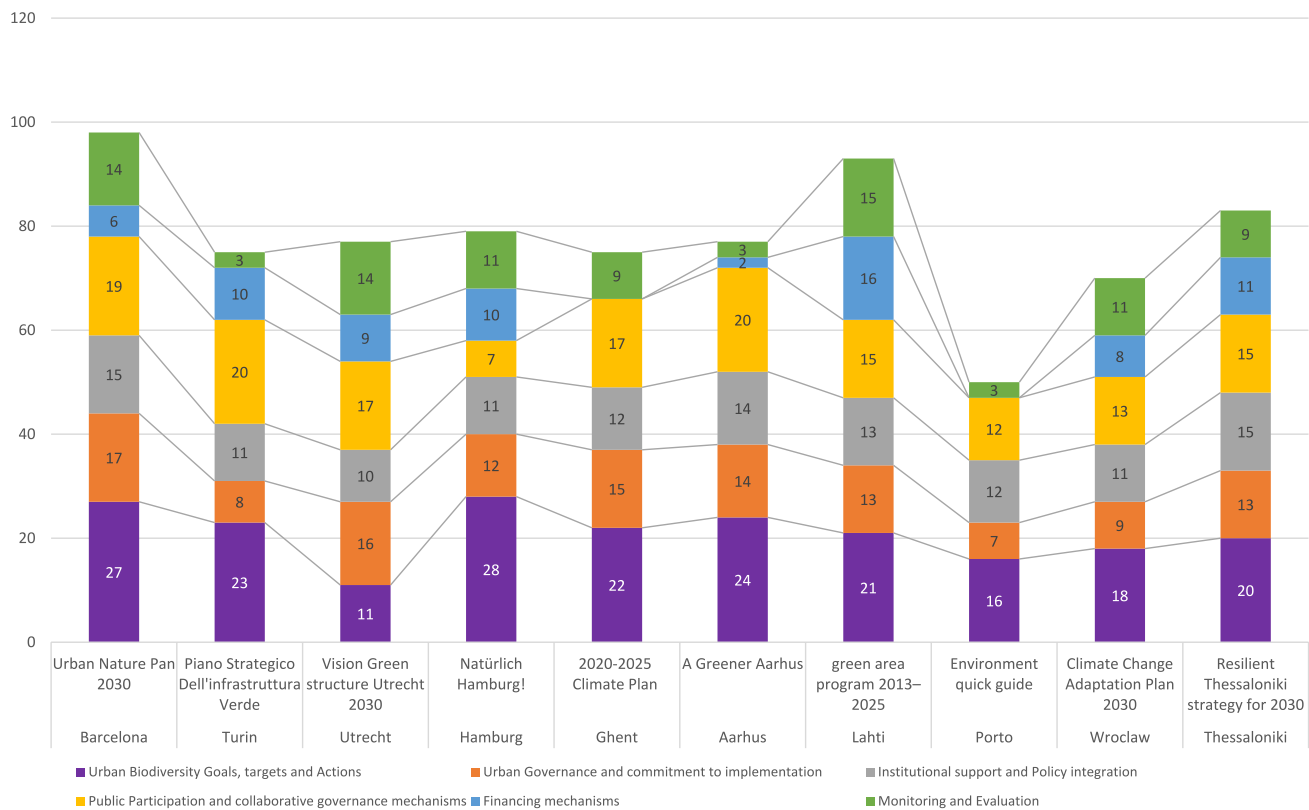


Fig. 4 Macro categories analysis for the sample of 10 selected cities based on the total score for each category. Source: the authors

Urban Governance and commitment to implementation

While with the governance and related context, we interpret the whole process in which the plan itself is design and executed (Øjvind Nielsen et al. 2024). The analysis reveals that some plans (3/10) (despite being over three years old) have ambitious targets on promoting and exchanging beyond municipal boundaries, such as Utrecht. The Barcelona Nature Plan 2030 (2021) looks exemplary from a governance point of view, as the plan itself is co-designed and shared across sectors within the same municipality (multi-sectorial) and involved citizens within shaping the plan actions. Lahti (2022) has developed an environmental governance section that treats through a peer review process the assessment of governing bodies performance over time.

Institutional support and policy integration

Very few cities (4/10) have created networks of actors and built institutional relations with organizations to be actively involved in the conservation (and conversation) of biodiversity and address actual challenges to improve residents' quality of life. In this aspect, Barcelona benchmarks the lead for actions promoted by citizen-involvement

schemes in nature actions and encouraged voluntary works such as co-responsibility activities (Barcelona 2021). Utrecht plan (2023) stands out for its integration and multi-sectoral approach, with full support from the city council. The city council has fostered open discussions with citizens through questionnaires and consultations on the development of the green spatial strategy 2040 in each neighbourhood. Aarhus (2024) similarly developed a co-creation strategy for the green projects to be implemented in collaboration with citizens from all ages through local associations, green councils, educational programs or schools. This is a recurrent aspect also in the cases of Hamburg and Thessaloniki.

Public participation and shared governance mechanisms

While the main focus of most plans remains the nature preservation, some plans emphasize health (2/10) or citizen participation specifically (4/10). Barcelona UNP (2021) for instance highlights nature's role as support for people's physical health and emotional wellbeing. Particularly, in the urban context through greenery as one of the main strategies to adapt cities to climate change. In addition, an in-depth co-design and public participation process was conducted during the redaction of the plan itself starting 2020 and 2021 through

six sessions focusing on citizen engagement and participation for reaching a consensus on actions and proposals.

In Utrecht, citizens were engaged through co-planning or co-design processes for neighbourhood green spaces in the Center. The process began with a consultation workshop where residents selected 17 projects for newly planted or replaced greenery; then a group of citizens or community groups should take over the city council role to and self-manage the implementation. This approach empowers citizens and makes an evidence-case that through awareness raising and political support from the city council to “*share the governance*” process of the urban green plans, it is possible to overcome the general policy silos, financial and technical hurdles.

Financing mechanisms

A general observation is the lack of established financing mechanisms that give rights to nature and green as a broader sense. Despite being the most problematic category of evaluation on setting the specific criteria, the respective analysis from the cities showed a lack of clear trajectory for financing the biodiversity and urban greening interventions (2/10 cities scored 0). Often, the interventions are publicly owned while the maintenance costs and the public participation in the design and development processes do fall on the private or third sector responsibility, like Turin (2020).

Only one city, Lahti scored a full 16 points as it established a clear long term plan to finance their interventions; while encouraging the private sector to participate in the budgeting process and conducting an external impact assessment to their goals. Lahti (2022) also stands out for launching a co-creation platform where future urban and environmental projects are showcased and potentially financed through a larger city strategy committing to 2030.

Monitoring and evaluation

The key challenge in evaluating this category is identifying the right matrices that could be used by cities to measure their own advancements in urban biodiversity without performing negatively; especially the ones related to accessibility and increase of urban greening without compromising other urban services. The overall picture for this category, remains the lowest scores for all cities; 3/10 cities score three over 20 points. Turin for instance reveals the difficulty of monitoring the interventions they put in place especially due to the prioritization of the maintenance budget for the safety and security in response to extreme climate risks events such as floodings. The plan lacks a clear measured impact from the monitoring process due to short term planning since it does not convey a futuristic perspective on what is the next step. On the contrary, Lahti (2022) demonstrates a successful

continuous monitoring strategy to track the effectiveness of the goals and indicators as set by the plan ensuring a smooth citizen active participation.

Takeaways and recommendations for policy

An ambitious UGP/UNP does not necessarily have to be a one size fits all, as not all the EU cities have the same resources or face the same environmental, social or economic challenges. Since this research aims to evaluate the ambition level of UGPs to track progress toward target 14 of the EU Biodiversity Strategy 2030. The authors believe it's essential for an effective ambitious plan to meet certain criteria as highlighted followingly:

Spatial dimension

- i. The governance of urban biodiversity actions and targets operates beyond one spatial scale. Some cities do establish their actions on the overall metropolitan scale/FUA and some other at the neighbourhood scale. However, citizen engagement clearly happens at the local scale in which people can directly influence their immediate surroundings.
- ii. Wroclaw (2019) was the only city having a plan on the FUA scale. This is partly due to its smaller size in comparison to Barcelona for instance. The city had an established “*Office of Nature and climate protection*” which clearly has competences related to the sustainable development plan of the city but, also a clear matter of governance at the urban scale.
- iii. Data collection of plans could be standardized through a central system, as recommended in the EC guidance rightly. However, not all cities are aware about its exploitation possibility, hence a physical distribution could be explored.
- iv. The accessibility matrix to green areas within 10–15 min (Annex 3) is an existing database that local authorities may not be aware of. A possible enabler could be to develop a neighbourhood accessibility matrix instead of the city-wide accessibility.

Analytical dimensions

- i. Many plans focus on tree-planting initiatives; however, this should be one part within the overall of the plan's actions and not the sole action. This proliferation stems from the EU's target to plant three billion additional trees by 2030.²⁰

²⁰ <https://forest.eea.europa.eu/3-billion-trees/introduction>

- ii. Two cities out of the 10 had a detailed green roofs and green factor strategy (Hamburg and Malmö), almost independent of their climate adaptation strategy or green/nature plans. This has distinct implications for the category of urban biodiversity actions, goals and targets since it is easier to evaluate punctual interventions.

Lastly, the possibility of having better **biodiversity-inclusive urban planning**, as recommended under target 12 of the GBF, could be explored through the following:

- i. The biodiversity actions and targets should be clearly stated and designed from the start of the planning process, otherwise without specific targets, integrating biodiversity later in the process may feel disconnected and lacks coherence.
- ii. Putting co-creation with citizens at the heart of the process is a fundamental part of the plan success, and long-term managerial and financial commitments by bringing all stakeholders on board from the beginning.
- iii. Ensuring the participation of different socio-demographic categories is a essential for inclusivity but remains challenging; the city of Lahti's plan included a dream playground program which incorporates urban natural areas in early childhood educational systems.
- iv. An effective financial mechanism to ensure public spending is oriented towards the actual implementation of urban nature plan is crucial; it increases credibility of the city officials and increases local communities' interest in projects.

Conclusions and future research

To track the progress on urban greening plans across EU cities with at least 20,000 inhabitants, a possible way forward would be to first review the Climate Action Adaptation plans of the EU cities to check if they mention nature-based solutions (often overlapping with UGP/UGN), hence track the progress based on the existing monitoring frameworks in the urban planning departments of municipalities. Additionally, an online platform with all the cities volunteering to self-assess their urban green plan as candidate for evaluation. Future research could include the monitoring of nature restoration targets as legally defined in the recently approved Nature Restoration Regulation.²¹

Since 39% of the European population lives in cities and 35% in towns and suburbs,²² target 14 of the EU Biodiversity Strategy encourages municipalities to develop UNP. However, since the coordination and reporting at EU level is not legally required, there is no common understanding, repository or tool for the EU to track progress towards this target (Viti et al. 2024). The Urban Greening Platform and the revived Commission expert group on Green Infrastructure are good attempts to indirectly support actions to reach the target. Hence, national authorities are encouraged to coordinate, mobilise resources and platforms to support cities and municipalities reaching target 14.

While target 12 of the GBF covers many aspects of urban planning and well-being that could be monitored with different indicators (e.g. connectivity, access to green/blue areas, human health), this research work focused on the aspect of biodiversity-inclusive urban planning (CBD 2022). A key takeaway is the importance of communication with the citizens and develop co-creation and public participation mechanisms ensuring information flow is clear and simplified. Tracking the progress of the plan from start, planning, adoption and realization makes it closer to citizens minds, whether using social media, public relations campaigns, school programs and surveys or any other instruments. To conclude, a good plan is a well-governed plan; an ambitious plan is an inclusively governed plan.

Research limits

Cities selection: initially, the target 14 includes all cities with at least 20, 000 inhabitants in the EU. Due to the large sample size, the study was narrowed to the FUAs within 27 Member States then the sample downscaled to cities benchmarked by experts and in open access databases for easier data collection. Larger samples of cities including all FUAs (14 k cities in 2022) would require a larger group of researchers or institutions, even if only just checking if they have an UGP or not. Noticeable feedback was also received from some cities highlighting urban governance hindrances preventing them from the establishment of their urban green plans, despite being part of the 100 cities mission. Future research would include the cities that by far have not established their urban nature plans and investigate the possible governance barriers they face.

Criteria selection: this research involved experts on biodiversity and NBS from different spectrums, with a primary focus on governance aspects of urban biodiversity; hence, some subtopics related to habitat quality and richness as well as finances or ecosystem services topics were

²¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1991>

²² Statistics Explained: Urban Europe, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Urban_Europe

not fully considered. In terms of methodological limitations, the authors recognize that the framework mainly addresses collaborative governance angle, but a more comprehensive approach would also include indicators on flora, fauna and include habitats and birds' directives.

For bias control: to minimise bias, external experts from another research group not involved in the criteria selection process and were consulted to evaluate Hamburg and Turin using the same set of criteria. The evaluations were consistent, more information in supplementary material.

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Author contribution I.M. did the research Conceptualization, Methodology, Software, Data curation, Visualization, Validation, Resources, Writing—Original draft preparation, Writing—Review & Editing, Funding acquisition, Project administration. G.D., C.L., M.R. Writing—Review & Editing, Resources, Supervision. All Authors agreed on the submitted manuscript.

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Data availability Data is provided within the manuscript supplementary information files, for more information write to the corresponding author.

Declarations

Competing interests The authors declare no competing interests.

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