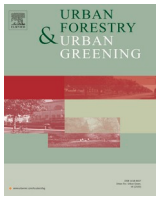
Urban Forestry & Urban Greening 87 (2023) 128067

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

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



Review

With the process comes the progress: A systematic review to support governance assessment of urban nature-based solutions

Alexander P.N. van der Jagt [a,b,*], Arjen Buijs [b], Cynnamon Dobbs [c,d], Martina van Lierop [e], Stephan Pauleit [e], Thomas B. Randrup [f], Andrea Skiba [e], Tom Wild [g]

[a] The Urban Institute, School of Energy, Geoscience, Infrastructure and Society, Heriot-Watt University, Edinburgh EH14 4AS, United Kingdom
[b] Forest and Nature Conservation Policy Group, Department of Environmental Sciences, Wageningen University & Research, Droevendaalsesteeg 3, 6708 PB Wageningen, the Netherlands
[c] Natural Resources and the Environment, University of Connecticut, 1376 Storrs Road, Unit 4087, Storrs, CT 06269-0132, United States
[d] Center for Ecosystem Modeling and Monitoring, School of Forestry, Universidad Mayor, José Toribio Medina 29, Santiago, Chile
[e] Chair for Strategic Landscape Planning and Management, School of Life Sciences Weihenstephan, Technical University of Munich, Emil-Ramann-Str. 6, 85354 Freising, Germany
[f] Department of Landscape Architecture, Planning and Management, Swedish University of Agricultural Sciences, Box 190, 234 22 Lomma, Sweden
[g] Department of Landscape Architecture, University of Sheffield, Floor 13 The Arts Tower, Western Bank, Sheffield S10 2TN, United Kingdom

ARTICLE INFO

Handling Editor: Dr Cecil Konijnendijk van den Bosch

Keywords:
Environmental governance
Environmental assessment
Urban nature-based solutions
Environmental justice
Governance indicators
Community-based knowledge
Participatory monitoring

ABSTRACT

The last decade has seen a profound increase in the development of assessment frameworks for ecosystem services, green infrastructure and nature-based solutions (NBS). This has improved understanding of NBS impact assessment, including processual aspects related to participatory planning and governance. We argue that, although representing a move in the right direction, NBS assessment frameworks would benefit from a broader framing of governance, including the role of government-led laws, policies and regulations along with community-led and collaborative multi-stakeholder initiatives. The consideration of marginalised communities and environmental justice should also be strengthened. To ensure a feasible and comprehensive approach to NBS governance assessment, we carried out a systematic literature review on the topic of urban NBS governance. Using thematic analysis, we developed a framework of five themes encompassing nine governance dimensions, of which some are further broken down into sub-dimensions. To assess the different NBS governance dimensions, we developed a tool in the format of a survey for urban decision-makers and other stakeholders, encompassing nine urban NBS governance indicators corresponding with the identified dimensions. Further to complementing NBS governance assessment approaches in important ways, we were able to highlight knowledge gaps around integrating features of the planning process and community-based or traditional knowledge. Our tool for monitoring urban NBS governance is simple to use and provides cities with a low-cost and comprehensive approach for monitoring and evaluating their readiness for mainstreaming NBS.

1. Introduction

Urban governance in the Anthropocene is recognised as being inextricably linked to addressing global sustainability challenges. Both individual leadership and collective action – aspects central to governance – are required to re-establish socio-ecological connections and advance planetary stewardship, reducing our environmental footprint in this human-influenced epoch (Tengö et al., 2022). Cities increasingly act as arenas for a multiplicity of experiments connecting climate action with challenges around food, energy, biodiversity and social justice, collectively seeking to build momentum for transforming economic systems and urban development practices (Bulkeley, 2021; Xie & Bulkeley, 2020). Nature-based solutions (NBS) are innovative examples of "ecological commons" that could help to "radically transform" cities, contributing to more sustainable and resilient societies (McPhearson et al., 2021). The planning and implementation of NBS is part of a global effort to address interlinked climate change and biodiversity crises, support healthy urban living, and achieve environmental justice

* Corresponding author at: The Urban Institute, School of Energy, Geoscience, Infrastructure and Society, Heriot-Watt University, Edinburgh EH14 4AS, United Kingdom.
E-mail address: s.van_der_jagt@hw.ac.uk (A.P.N. van der Jagt).

https://doi.org/10.1016/j.ufug.2023.128067
Received 22 May 2023; Received in revised form 19 July 2023; Accepted 22 August 2023
Available online 23 August 2023

(Bayulken et al., 2021; Cousins, 2021), featuring prominently in global policy arenas and championed by transnational coalitions and initiatives (Xie et al., 2022).

As a result of this global policy interest, the development of urban NBS assessment frameworks has mushroomed in recent years (van der Jagt, Buijs, et al., 2023). Prominent examples include the EKLIPSE Impact Evaluation Framework (Raymond et al., 2017), the IUCNs (2020) Global Standard and the European Commission's Handbook for Evaluating the Impact of Nature-Based Solutions (hereafter: EC Handbook) (Dumitru & Wendling, 2021). The latter was published most recently and "serves as a comprehensive reference handbook, based upon current best available knowledge and state-of-the-art technologies and practices" (Dumitru & Wendling, 2021, p.25). It provides indicators to assess performance of (urban) NBS against variables pertaining to a range of societal challenge areas, such as climate resilience, biodiversity enhancement and public health and wellbeing and most indicators are also relevant to urban contexts. Unlike the IUCN Global Standard for NBS it also includes an appendix with detailed descriptions of assessment procedures for each indicator, including relevant assessment scales and scope for participatory assessment. Hence, we consider it as the most suitable baseline against which to compare the indicators developed in this study.

The EC Handbook developers also included participatory planning and governance indicators for monitoring processual aspects important to the development and mainstreaming of NBS. Processual aspects, including governance, are understood to underpin the realisation of benefits from nature (Raymond et al., 2017). This is also reflected in Criterion 5 of the IUCN Global Standard for NBS assessment framework: "NbS are based on inclusive, transparent and empowering governance processes" (IUCN, 2020, p.14). Governance issues around e.g., limited knowledge availability and lack of collaborative arrangements represent well-known barriers to NBS implementation and mainstreaming (Dorst et al., 2022; Wild et al., 2020). In sum, by monitoring the effectiveness and inclusiveness of NBS governance and planning, urban decision-makers can identify and respond to pinch points in renaturing their city, which supports the equitable mainstreaming of NBS.

We argue that the EC Handbook, a recently published compendium drawing from over 20 research projects and representing the state-of-the-art in NBS assessment, remains insufficiently capable to provide comprehensive governance assessments. Aspects such as institutional frameworks, actors and their related discourses, resources and power dynamics, key to environmental governance (Arnouts et al., 2012; Lawrence et al., 2013), are inadequately captured. Although a bespoke tool for monitoring urban NBS "delivery capabilities" was recently developed (Croeser et al., 2021), this is exclusively focuses on institutional processes and therefore not at the interactions between governmental and non-governmental actors influencing urban NBS development. Adopting a broad conceptualisation of urban NBS governance, we advocate to include new indicators that address these governance factors and qualities. We address the following objectives: 1) Develop an understanding of the different dimensions important to effective and equitable urban NBS governance based on a systematic review; 2) Define governance indicators mapping on each of these dimensions, providing a feasible approach for urban decision-makers to comprehensively assess NBS governance; and 3) Compare the elaborated indicators with those in the state-of-the-art EC Handbook to demonstrate how our elaborated indicators could complement the current practice in urban NBS governance assessment.

2. Critiquing the state-of-the-art in NBS governance assessment

The term 'governance' came into vogue within political science in the late 20th century following the rise of neoliberalism, resulting in a push for decentralisation, deregulation and privatisation (Arts, 2021; Skelcher, 2000). Governments increasingly partnered with entrepreneurs, civil society and community organisations to deliver upon public objectives, whilst they were also encouraged to experiment with new ideas or solutions to societal problems (Bulkeley et al., 2016; Hajer et al., 2015; Swyngedouw, 2005; Wolfram, 2018). Some scholars therefore understand governance in a narrow way as non-hierarchical modes of steering (Héritier, 2002), or limit their analysis of governance to NBS practices with no active government involvement (Mattijssen et al., 2018; Rigolon & Gibson, 2021). Governance is, however, more commonly understood as "the coordination of collective action by public and private actors to address societal problems and opportunities" (Arts, 2021, p.14), often with a specific focus on (environmental) problem-solving (Driessen et al., 2012; Kooiman, 2003).

Different modes of governance can be distinguished to describe the various multi-actor networks and steering configurations involving governments, businesses and civil society (Lange et al., 2013; Treib et al., 2007). For example, *hierarchical governance* for top-down decision-making by public actors, *interactive governance* where government and non-governmental actors share decision-making power, or *self-governance* where decision-making is delegated from public to private actors. Recent studies demonstrate the importance of co-governance and self-governance in the development and mainstreaming of urban NBS (Ambrose-Oji et al., 2017; Egusquiza et al., 2019; Frantzeskaki et al., 2019; Martin et al., 2021), and urban sustainability transformations more broadly (Frantzeskaki et al., 2016; Frantzeskaki & Tilie, 2014). This is reflected in the EC Handbook and other NBS assessment frameworks amalgamated into this, which are largely tailored to monitoring interactive and beyond-the-state modes of governance. We contend that governance factors enabling a government-led mode of governance are insufficiently integrated into the EC Handbook. The frameworks focus too little on the role of, inter alia, policy instruments and planning frameworks in steering collective action, i.e. they use a narrow conceptualisation of governance largely overlooking the hierarchical mode of governance.

The role of governments in urban NBS governance should not be underplayed. For example, a recent study on a database with nearly 1000 innovative urban NBS across Europe showed that whilst interactive modes of governance involving governmental and non-governmental actors were most prevalent (44%), just under one third of NBS initiatives were government-led, whilst just over a quarter of initiatives were led by non-governmental actors (Almassy et al., 2018). Governments thus play a central role in the development and implementation of innovative urban NBS. Corroborating this, research demonstrates that local, regional, national and supra-national governments contribute to the development and mainstreaming of urban NBS by employing policy instruments leveraging change across multiple scales and sectors (Kirsop-Taylor et al., 2021; van der Jagt, Tozer, et al., 2023; Xie et al., 2022). Added to this, government support and regulatory frameworks (e.g., tax regulations) can exert a powerful influence on initiatives led by non-governmental actors (Arts, 2021; Nederhand et al., 2019). For example, by a) providing leadership in areas, such as urban greening and climate action (e.g., Li et al., 2020); b) ensuring democratic control in decisions over public space (Toxopeus et al., 2020); and c) providing tailored support to NBS initiatives within marginalised communities (Buijs et al., 2016; Fors et al., 2021; Randrup et al., 2020).

Another issue with existing NBS assessment frameworks is that included governance indicators themselves tend to be narrowly focused too. For example, the EC Handbook includes some rather specific measures amongst the set of six recommended indicators, such as the number of public-private partnerships supporting NBS or the proportion of urban citizens involved in public participation activities. Other EC Handbook indicators require considerable effort or expertise in particular analytical methods to implement. For example, the indicator 'openness to participatory methods', recommended in the EC Handbook, requires not only the regular delivery of participatory processes, but also expertise in evaluating the quality and outcomes of such processes on measures such as transparency and equity.

Finally, we see scope for improving NBS assessment frameworks to

better understand how NBS governance interacts with *environmental justice* and indeed justice in ecosystem services (Langemeyer & Connolly, 2020). Increasingly, justice aspects of NBS are being discussed to consider the needs of, and give voice to, marginalised groups. Participatory forms of governance are only more inclusive if these engage and empower marginalised groups, and if governments' NBS investments are maintained over time (Pineda-Pinto et al., 2022; Toxopeus et al., 2020; van der Jagt, Buijs, et al., 2023). Whilst environmental justice may be monitored by mapping NBS impacts at the neighbourhood-city levels (*distributional justice*) and extensive stakeholder engagement (*procedural justice*), assessment frameworks afford limited city-scale insights into the intersections of governance and environmental justice, e.g., the degree to which diverse voices from local communities are recognised in decision-making (*recognition justice*), important in achieving just urban futures. We believe that rethinking how urban NBS interacts with inclusive decision-making and other aspects of environmental justice is especially pertinent in the Global South, given comparatively lower income, education levels, quality of water supply, sanitation infrastructure, environmental sustainability, and quality of life (Nagendra et al., 2018).

3. Methods

3.1. Review of governance dimensions

We seek to develop a comprehensive set of governance indicators based on a systematic review of governance dimensions important to successful uptake of urban NBS and green infrastructure and achieving environmental justice. The protocol for selecting relevant studies is shown in Fig. 1, which draws on the PRISMA approach for reporting systematic reviews (Liberati et al., 2009; Moher et al., 2009). The search terms 'nature-based solutions' and 'green infrastructure' were selected as each of these represent umbrella terms encompassing a broad range of (urban) greening interventions including e.g., green roofs, constructed wetlands and wildflower meadows (Pauleit et al., 2017). A total of 88 records were included in this review (Appendix A).

Following the selection of relevant records from Scopus, the main investigator analysed the full manuscripts to code relevant content. The coded incidents encompassed concrete actions and opportunities available to support urban NBS implementation. This excluded generic statements, such as the need for more funding or knowledge, without detailing the delivery mechanisms. An initial coding book was developed to thematically organise the relevant contents. This was based on the dimensions of the Nature-Based Innovation System framework (van der Jagt et al., 2020), synthesising factors enabling nature-based innovation in cities, many of which relate to governance. This is a related review but with different search terms given its focus on factors enabling innovation.

Next, the main investigator engaged in an iterative process of reviewing and comparing the coded contents for each dimension following the constant comparison method, involving a process of simultaneous coding and analysis (Glaser, 1965). This resulted in the renaming, combining or splitting of the original dimensions (i.e. codes) in the coding book, or creating new ones, to better reflect similarities and differences in the coded materials of this particular review. To improve validity, a second investigator then reviewed the dimensions and coded contents, resulting in further refinement of dimensions and subdimensions.

3.2. Development of the indicators

The systematic review resulted in nine dimensions and, for some, subdimensions. Next, we developed an indicator for each of the dimensions and combined these into a survey (Appendix B). To develop the indicators, the main investigator proposed a one-sentence summary for each dimension based on the descriptions in Section 4.1. Five co-investigators, two of which are based in Latin America, provided feedback upon which the questionnaire items were revised iteratively until all agreed with the formulated indicators. Following this, the survey was piloted by a board member of a UK-based Local Nature Partnership and

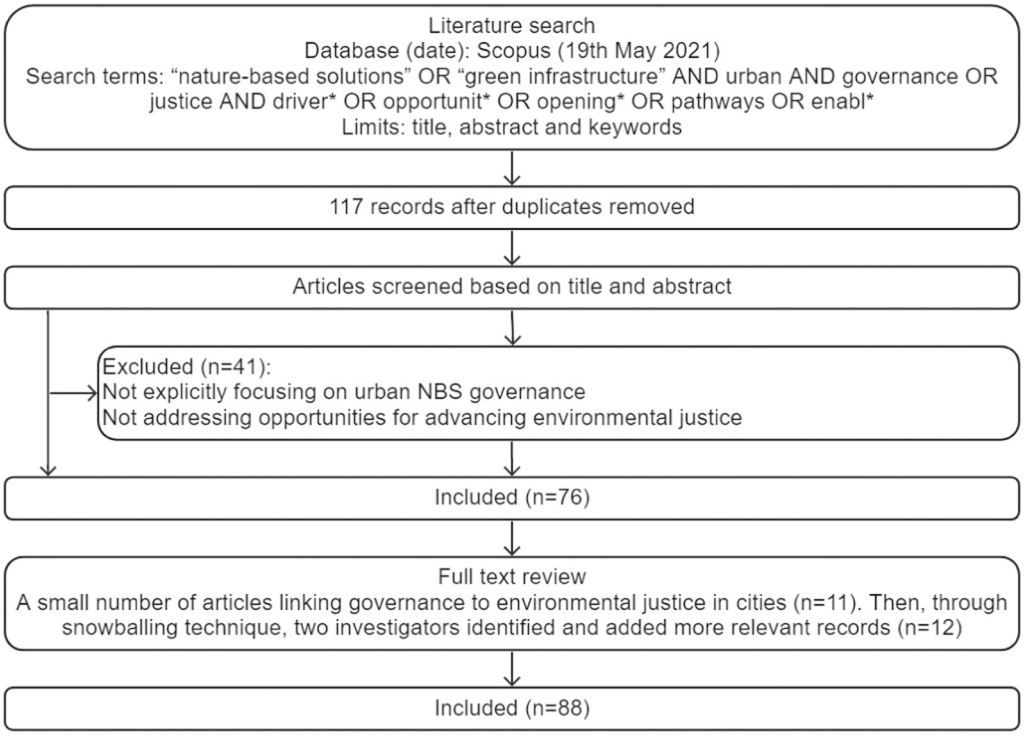


Fig. 1. Flow diagram of record selection.
Adapted from Liberati et al. (2009).

an expert from the Chilean Ministry of the Environment, using a translated version. They were sent the full survey, asked to complete it, and provide feedback on the following: a) Are all questions unambiguous and clear? b) Is the scoring rubric clear? c) Are any aspects important to urban NBS governance missing from the survey? d) Would the results of this survey be of relevance to your city? The feedback received was positive and no suggestions for improvement were made.

4. Results

4.1. The urban NBS governance review

The review of the literature on NBS governance resulted in nine governance dimensions, some of which are split into sub-dimensions, across five themes (Table 1). The findings were used to support the development of each of the (sub-)dimensions, as discussed below.

4.2. Agency

4.2.1. Institutional commitment to NBS

Institutional commitment to NBS, needs to persist regardless of shifts in the political or policy landscape (Ibrahim et al., 2020; Mell, 2020b; Shih et al., 2020). Therefore, NBS leadership and long-term commitment by politicians, municipalities and executive leadership is critical in generating support and guiding the planning, implementation and long-term management of NBS and related approaches (Dushkova & Haase, 2020; Li et al., 2020; Suleiman, 2021; Wamsler et al., 2016; Workalemahu Habtemariam et al., 2019; Zuniga-Teran et al., 2020). Such institutions are also centrally important in making NBS part of the dominant, or 'sanctioned', urban regime discourse (Mguni et al., 2015). Commitment can be expressed directly by developing visions, policies and regulations together with stakeholders, but also indirectly by supporting others to do more, for example, by providing resources and policy incentives to stimulate innovation, to involve the private sector or to strengthen bottom-up initiatives. By creating more awareness, openness and publicity, such engagements maintain pressure on politicians to support NBS over time. In addition, decision-makers should consider internal investment in professional development and adaptation of structures, formal norms and role descriptions supporting NBS development (Wamsler, 2015; Workalemahu Habtemariam et al., 2019).

Table 1
The thematically grouped governance indicators categorised into themes with underlying dimensions.

Theme	(#) Dimension	Sub-dimension
Agency	(1) *Agency*	Institutional commitment to NBS NBS advocacy by non-governmental actors
Institutional structure	(2) *Integrated working*	
	(3) *Legislation, regulations and policies*	
Collaboration and partnerships	(4) *Collaborative arrangements*	
	(5) *Active community engagement*	
Resources and data	(6) *Monitoring and assessment*	
	(7) *Knowledge development and sharing*	Access to relevant expertise Social learning based on reflexivity Environmental education
	(8) *Financing mechanisms*	
Environmental justice	(9) *Valuing diversity, equity and inclusion*	Recognising diverse perspectives Fair representation of stakeholders Ensuring equitable access to NBS outcomes

4.2.2. NBS advocacy by non-governmental actors

Engaging non-profits, community groups and research centres is widely recognised as a success factor to raise the profile and improve delivery of NBS. Such stakeholders can raise prospects for success by raising funds for projects, knowledge development and innovation, rethinking policy, outreach to the general public, coordinating social learning processes and lobbying powerful actors (e.g. politicians or influential adaptation networks) (Ibrahim et al., 2020; Kabisch et al., 2016; Larsson et al., 2018; O'Donnell et al., 2021; Suleiman, 2021; Wamsler, 2015; Wamsler et al., 2014, 2020; Workalemahu Habtemariam et al., 2019). The ability to bring a broad set of disciplines and stakeholders together, by means of creating a shared language, being open to new ideas and relating to their realities and priorities is essential for success (Campbell et al., 2016; Frantzeskaki, 2019; Kvamsås, 2021; Sarabi et al., 2020; Wamsler et al., 2014).

4.3. Integrated working

To generate broad policy support for NBS and related objectives (e.g., biodiversity enhancement and climate action), there is often a need to reconfigure or realign institutional (e.g., municipal) structures (Dorst et al., 2019; Pauleit et al., 2019; Randrup et al., 2020; Wamsler, 2015). For example, departments and sections can be reorganised to create new coalitions, or a boundary spanning organisation, group or individual can be appointed tasked with bridging different municipal departments (e.g., on spatial planning, environmental conservation or operational management). This supports knowledge sharing and renegotiating roles and responsibilities relevant to NBS development (Suleiman, 2021; Wamsler et al., 2014, 2016, 2020; Zuniga-Teran et al., 2020). External organisations such as universities and NGOs might be particularly suited to take up the role of boundary spanner (E. Andersson, 2018; Campbell et al., 2016; Workalemahu Habtemariam et al., 2019).

Relevant activities conducive to integrated working, and evidencing boundary spanning, include shared meetings, joint field trips, intersectoral project collaborations and consultation of a range of departments on new policies and plans (Wamsler et al., 2020). Success can also be measured through support for NBS development in environmental and cognate policy frameworks and operations, e.g., around sustainability, mobility, health and infrastructure upgrading (Aubrechtová et al., 2020; Dushkova & Haase, 2020; Mguni et al., 2015; Pasimeni et al., 2019; Wamsler, 2015; Wamsler et al., 2016; Wang et al., 2021).

4.4. Legislation, regulations and policies

An effective way to mainstream urban NBS is to mandate their inclusion as compulsory measures in land use policy and comprehensive planning (Clark et al., 2020; Kordana & Daniel, 2020; Sarabi et al., 2019; Wamsler et al., 2016). Mainstreaming can be further strengthened by protecting NBS on public and private land through municipal ordinances, byelaws or permit systems and the use of planning guidance or standards (e.g., on green space provision and quality or on environmental quality; Clark et al., 2020; Fan et al., 2017; Kordana & Daniel, 2020; O'Donnell et al., 2021; Zuniga-Teran et al., 2020). International-level laws and regulations may have similar effects at the municipal level (e.g., proposals for an EU Nature Restoration Law accompanied by urban greening targets; European Commission, 2022). Other relevant policy instruments include no net loss regulation, participatory planning approaches, sectoral strategies or management plans, setting goals and guidelines around nature-inclusive practices and ecosystem services assessment (BenDor et al., 2018; Dobbs et al., 2019; Duinker et al., 2015; Kowarik, 2019; Kvamsås, 2021; Ordóñez et al., 2019; Wamsler et al., 2020). National-level policies are important in setting a benchmark for nature-based innovation by municipalities (Shkaruba et al., 2021). The public procurement system also provides an

avenue to mandate urban NBS, for example by including a requirement for pro-environmental measures in the application process (Kordana & Daniel, 2020).

4.5. Collaborative arrangements

Partnerships between different institutions and organisations are vital for sharing and coordinating funds, skills and knowledge on NBS development (Ahmed et al., 2019; Draus et al., 2019; Duinker et al., 2015; Frantzeskaki, 2019; Kowarik, 2019; Larson et al., 2013; Li et al., 2020; O'Donnell et al., 2021; Sarabi et al., 2019; Schifman et al., 2017; Wamsler, 2015; Wamsler et al., 2020; Zuniga-Teran et al., 2020). This is crucial for social learning, shared visioning, stakeholder empowerment and innovation (Dushkova & Haase, 2020; Kabisch et al., 2016; O'Donnell et al., 2018; Schifman et al., 2017).

To build effective partnerships, one first needs to understand the broader urban system, e.g. relevant sectors, coalitions and policies, in which NBS need to be integrated, along with the associated stakeholders (professionals, local communities and private companies) (Larson et al., 2013). Actors with local socio-ecological knowledge (e.g., regarding traditional land-based traditions and customs) should also be included (Cousins, 2021; Gulsrud, Hertzog, et al., 2018). These partnerships should not result in the loss of government control over key urban public assets (Mell, 2020a; Toxopeus et al., 2020).

Cross-scale partnerships are also important in raising the profile of NBS, e.g., around spatial data integration from urban and regional scales (K. Andersson et al., 2013; Aubrechtová et al., 2020), between local and regional planning authorities, and in translating high-level policy frameworks (e.g., UN Sustainable Development Goals) to lower scales (Mell, 2020b; Rogers et al., 2020; Workalemahu Habtemariam et al., 2019).

4.6. Active community engagement

Community engagement beyond passive consultation improves cultural expression and sense of belonging, social cohesion, the identification of innovative solutions, user experience, public awareness, support for urban NBS, environmental stewardship and environmental justice (E. Andersson, 2018; BenDor et al., 2018; Buijs et al., 2016, 2019; Campbell et al., 2016; Campbell-Arvai & Lindquist, 2021; Clark et al., 2020; Cousins, 2021; Dushkova & Haase, 2020; Ferreira et al., 2020; Finewood et al., 2019; Gulsrud, Hertzog, et al., 2018; Larson et al., 2013; Mguni et al., 2015, 2016; Nastran & Regina, 2016; O'Donnell et al., 2021; Randrup et al., 2020; Shih et al., 2020; Wamsler et al., 2016, 2020). There are many ways to approach this, e.g., through community management or ownership of NBS, temporary management of abandoned areas, incentivising grassroots NBS projects, crowdsourcing, scenario building, storytelling, focus groups and other platforms and methods for dialogue and exchange (e.g., Buijs et al., 2019; Frantzeskaki, 2019; Gulsrud, Raymond, et al., 2018; Toxopeus et al., 2020; Trentanovi et al., 2021).

Citizen management or co-ownership of NBS, provided it is not a cover up for government divestment, can be an empowering form of participation (Donaldson & João, 2020). It requires supporting local initiatives with fundraising, financial incentives, donations, project management and legal affairs (Buijs et al., 2019; Clark et al., 2020; Dushkova & Haase, 2020; Mell, 2020a; Schäffler & Swilling, 2013), particularly if serving a marginalised community (Buijs et al., 2019; van der Jagt et al., 2021). Municipalities should facilitate social learning opportunities for local initiatives (Buijs et al., 2016). Where possible, tailored support should be provided to marginalised communities, e.g., ethnic minorities, children, low-income groups, elderly people and diverse abilities, to ensure equal opportunities around influencing environmental decision-making (Kabisch et al., 2016; Steen Møller et al., 2019; Toxopeus et al., 2020). Local initiatives benefit from a clear set of rules or guidelines, spelling out the rights and responsibilities (e.g., around permitted stewardship activities or internal management structure) (E. Andersson, 2018; Buijs et al., 2016, 2019; Langemeyer et al., 2018). Local communities also need practical support, with a contact person answering practical questions or by sharing tools and equipment (Buijs et al., 2019; Wamsler et al., 2020).

Participation in citizen science or crowdsourcing can be supported with a range of applications and technologies, including volunteered geographic information (VGI), e-tools and the Internet of Things (i.e. the networking of portable devices using the internet) (Campbell et al., 2016; Gulsrud, Raymond, et al., 2018; Steen Møller et al., 2019; Wild et al., 2019; Zevenbergen et al., 2018). Such tools can support understanding of NBS preferences and perceived areas for improvement by different social groups (Gulsrud, Raymond, et al., 2018; Sarabi et al., 2019), and are most effective if co-developed with a varied group of stakeholders (Gulsrud, Raymond, et al., 2018; Steen Møller et al., 2019).

4.7. Monitoring and assessment

Impact assessment is crucial to tailor NBS to place-specific problems such as local climate and biodiversity conditions, challenges and user preferences (E. Andersson, 2018; Gulsrud, Hertzog, et al., 2018; Larson et al., 2013; Shih et al., 2020), to fully meet their potential as multifunctional sustainability innovations (E. Andersson, 2018; BenDor et al., 2018; Fink, 2019; Pauleit et al., 2019). Learning from success and failure requires monitoring, which can help to make the case for, inter alia, more investments in the development and management of NBS (Li et al., 2020; Lin et al., 2019; O'Donnell et al., 2021). Monitoring should also account for the negative externalities of NBS including vector-borne diseases, allergy responses and tree-related nuisance (Dobbs et al., 2019). NBS could be integrated in compulsory impact assessments of projects and policies (e.g. Strategic Environmental Assessment in Scotland) to ensure more data on their impact is provided and improve uptake (Donaldson & João, 2020). Long-term monitoring should be established to build a comprehensive picture of natural resources, their characteristics and management history (K. Andersson et al., 2013; Trentanovi et al., 2021).

Place-specific environmental understanding should be complemented by efforts to map social, economic and cultural diversity in cities, neighbourhoods and communities (Mell, 2020a; Mguni et al., 2016). Decision-makers should therefore build a picture of how green- and blue spaces could help to redress socioeconomic inequalities or reinforce green gentrification (Cousins, 2021; Gulsrud, Hertzog, et al., 2018; Zuniga-Teran et al., 2020). Relevant metrics include data on tree cover and blue/greenspace availability and proximity, whilst survey-based measures on use and access to NBS in the city are also an option (Benton-Short et al., 2019; de Vries et al., 2020; Dobbs et al., 2019; Haase et al., 2017; Nielsen et al., 2017). Other relevant measures explore urban nature preferences, attitudes and values, which can be monitored using e.g., surveys or more qualitative modes of enquiry such as on-site interviews (Buijs et al., 2019; Li et al., 2020; Lin et al., 2019).

4.8. Knowledge development and sharing

4.8.1. Access to relevant expertise

NBS design, planning, implementation, management and monitoring hinges on a broad knowledge base spanning multiple sectors (see Section 4.2.2 & Kvamsås, 2021). Landscape architecture, and more broadly ecological knowledge, for example, contributes to selecting appropriate plant species with the potential to thrive in harsh urban conditions, now and in more extreme future climates, whilst also supporting biodiversity (Benton-Short et al., 2019). Furthermore, expertise in design, engineering and performance monitoring of NBS such as sustainable urban drainage systems is required to integrate and maintain NBS in the built fabric (Kordana and Daniel, 2020; Mguni et al., 2016; Sarabi et al., 2019; Wang et al., 2021; Workalemahu Habtemariam et al., 2019).

Importantly, urban decision-makers need to have good awareness of

available policy instruments and funding options for NBS development (Shih et al., 2020; Tiwary et al., 2020; Wang et al., 2021). Understanding the broader institutional framework and socio-ecological system context is also key. For example, the informal planning systems in some contexts in the Global South enable and constrain particular measures and strategies when compared to more formal planning systems in the Global North (Herslund and Mguni, 2019; Mguni et al., 2016). Expert guidelines should therefore be made available in different languages and with the contents adapted to specific geographic and socio-political settings (Dobbs et al., 2019). Cities benefit from inspiring examples from places with a similar level of sustainability ambition and comparable political landscapes (Fink, 2019). Available expertise, where possible, should be captured and shared on global knowledge platforms, such as Oppla and ThinkNature (Kabisch et al., 2016; Sarabi et al., 2019).

4.8.2. Social learning based on reflexivity

Mainstreaming NBS requires experimentation with different approaches for supporting the uptake of NBS, monitoring the effects of these, and using new insights to fine-tune strategies and instruments (Wamsler, 2015; Wamsler et al., 2014; Zevenbergen et al., 2018). Practitioners, policymakers and researchers should engage in social learning based on a non-linear approach to steering and management (E. Andersson et al., 2014; Kabisch et al., 2016; Mguni et al., 2016) – a process informed by different cycles or iterations of dialogue and deliberation (Randrup et al., 2020). Such partnerships have also been defined as holistic Learning and Action Alliances, Living Labs or Life Labs (O'Donnell et al., 2018), supporting a shared understanding of challenges, and the co-development of visions, objectives and NBS assessment approaches (Kuller et al., 2019; Lin et al., 2019). Their reflexivity can encourage responsiveness to new insights in decision-making on urban NBS (Campbell et al., 2016; Suleiman, 2021) – each NBS, supportive policy or tool is an opportunity for knowledge and skills development (Frantzeskaki, 2019; Frantzeskaki et al., 2021; Sarabi et al., 2019; Wamsler et al., 2014). Soft skills (i.e. tacit knowledge) in group facilitation, community outreach and teamworking are essential in communicating effectively with a range of different audiences internal and external to the municipality (K. Andersson et al., 2013; Buijs et al., 2019; Shih et al., 2020).

To provide space for the expression of nature-based spirituality, culture and political activism, conducive to the development of environmental stewardship – local initiatives need to be granted the freedom to adopt a variety of NBS management styles (Langemeyer et al., 2018). Hence, there should be scope for urban communities managing urban NBS to inform institutional policy and practice following a mosaic governance approach (Buijs et al., 2016, 2019; Dorst et al., 2019; Gulsrud, Hertzog, et al., 2018). This provides a place-based approach to urban NBS governance tailored to community identities and practices, which takes into account the presence of actor-networks, availability of resources, power imbalances and the local geography (Buijs et al., 2016; Pauleit et al., 2019; Zuniga-Teran et al., 2020).

4.8.3. Environmental education

There is a need for NBS that enable the public to connect with nature in multiple ways beyond the cognitive or rational component, including on physical, emotional and spiritual levels. To improve public awareness and build support for urban NBS, insights gained from training, experimentation and social learning should be made broadly available – in accessible formats – to stakeholders and the general public (Mguni et al., 2015; Ordóñez et al., 2019). Therefore, municipalities should consider investing in demonstration projects and environmental education (e.g., food growing festivals and fairs) (Dushkova and Haase, 2020). Direct participation of citizens in stewardship activities such as ecosystem monitoring or networked bottom-up greenspace initiatives can also support the development of new knowledge and connectedness with nature (Ahmed et al., 2019; E. Andersson et al., 2014; Buijs et al., 2019; Frantzeskaki, 2019; Mguni et al., 2015; Wamsler et al., 2020; Zuniga-Teran et al., 2020).

4.9. Financing mechanisms

In addition to direct investment in NBS, municipalities and other key actors can use fiscal instruments, grants, subsidies or other incentives to mobilise other actors (Duinker et al., 2015; Sarabi et al., 2019; Suleiman, 2021). Some have argued that NBS might be funded under land value capture instruments such as tax increment financing, whilst developer exactions or impact fees should be charged to pay for the creation and protection of valuable public spaces (Dyca et al., 2020). The integration of ecosystem services into asset management needs improvement to unveil the large opportunity cost of investing in grey rather than green infrastructure – especially if taking into account its capacity for asset appreciation rather than depreciation over time (Schäffler and Swilling, 2013). To further accelerate urban NBS uptake, municipalities should explore co-funding mechanisms for NBS, such as park trusts, in-kind contributions by civil society, public-private partnerships and compensatory measures by the real estate sector (Kordana & Daniel, 2020; Li et al., 2020; Mell, 2020a; Mguni et al., 2015; O'Donnell et al., 2021; Zuniga-Teran et al., 2020). Alternative funding streams such as charging for firewood, food products, parking spaces near reserves or park activities and events could also be explored. Finally, co-funding could also be unlocked by integrating NBS into certification systems for sustainable housing (e.g., BREEAM) (Zuniga-Teran et al., 2020).

4.10. Valuing diversity, equity and inclusion

4.10.1. Recognising diverse perspectives

The use, knowledge and valuation of urban nature and biodiversity varies across cultural, age and socio-economic groups (Botzat et al., 2016; Elands et al., 2019; Gabriel, 2016; Kloek et al., 2013; Nesbitt et al., 2018). To achieve recognition justice, NBS should therefore build on local or traditional knowledge and be aligned with the needs, values and preferences of relevant sociocultural groups and place-specific communities, particularly marginalised groups such as immigrants, indigenous peoples and young people (Donaldson & João, 2020; Langemeyer & Connolly, 2020; Randrup et al., 2020; Toxopeus et al., 2020). This calls for participatory design, implementation, management and monitoring of NBS with local people and other stakeholders (Rutt and Gulsrud, 2016), informing a tailored approach acknowledging group-specific obstacles to NBS accessibility, such as safety concerns for women, children and elderly people (Assmuth et al., 2017; Langemeyer & Connolly, 2020).

A first step in recognising plurality is seeking or organising spaces for deliberation, and exchanges of views and preferences (de Oliveira Fontes, 2020). Recognition justice thus starts with acknowledging that varied experiences, interests, aspirations, knowledges, capabilities, intersectionalities and socioecological challenges should all be part of the NBS discourse (Frantzeskaki, 2019). To deliver socio-ecologically just cities, decision-making needs to heed to how different groups are interconnected with nonhuman species and ecosystems at different scales, as well as consider nature's own agency (Pineda-Pinto et al., 2022).

4.10.2. Fair representation of stakeholders

To better understand and respond to intersectionality and achieve procedural justice, decision-makers should provide equal opportunities for diverse stakeholders in policy-making, planning, analysis, management and decision-making relevant to urban nature (Hobbie and Grimm, 2020). This includes decisions on potential locations, user amenities and safety measures, as well as neighbourhood-level analysis and policy-making (Benton-Short et al., 2019). Procedural justice is closely aligned with recognition justice because its achievement depends on a good understanding of diverse perspectives and needs between e.g., age, ethnic, income and gender groups.

When organised in an inclusive, equitable, transparent and responsive manner, interdisciplinary stakeholder participation contributes to aligning top-down strategies and decisions with diverse and potentially contrasting place-based needs and preferences (Coenen, 2009; Hansen et al., 2017; Hobbie and Grimm, 2020; Langemeyer & Connolly, 2020; Meerow and Newell, 2019; Reed et al., 2018; Schifman et al., 2017), legitimising and empowering diverse urban communities (Pineda-Pinto et al., 2022). Achieving procedural justice require an iterative process of asking questions around who benefits and who loses, and doing so for groups across different spatial and temporal scales (Langemeyer and Connolly, 2020; Meerow and Newell, 2019).

4.10.3. Ensuring equitable access to NBS outcomes

Recognising diverse perspectives and achieving a fair representation of stakeholders in NBS development represent key stepping stones towards the fair distribution of environmental benefits and burdens (Benton-Short et al., 2019; Langemeyer and Connolly, 2020; Nesbitt et al., 2018; Rutt & Gulsrud, 2016). Marginalised communities have relatively low public green space accessibility (Benton-Short et al., 2019; de Vries et al., 2020; Ferguson et al., 2018; Haase et al., 2017), in some places also of lower quality (de Vries et al., 2020; Haase et al., 2017), whilst access to private greenspaces, such as green backyards and golf courses, is also limited (Haase et al., 2017; Nesbitt et al., 2018). Moreover, marginalised communities have higher vulnerability to climate hazards such as urban heat islands, erosion or flooding, and limited access to mitigating measures such as stormwater infrastructure, air quality amelioration and heat island mitigation important to climate resilience (Hobbie and Grimm, 2020). Therefore, some scholars argue for restorative justice (Hazrati and Heffron, 2021), which would imply investing more in NBS in historically disadvantaged communities than elsewhere in the city. However, several studies have pointed out a potential risk of environmental gentrification, resulting in the displacement of people with fewer financial resources from such revitalised areas (Gould and Lewis, 2017; Haase et al., 2017). This calls for the deliberation of long-term socio-spatial effects of NBS in the design and planning stages (Haase et al., 2017).

4.11. From dimensions to indicators: a survey-based instrument to monitor urban NBS governance

Based on the governance dimensions described in Section 4.1, we developed a nine-item survey-based instrument to monitor progress towards urban NBS governance for sustainable and just cities (Appendix B). The survey was designed to provide a feasible and comprehensive approach to NBS governance assessment, allowing for it to be applied across a range of geographical contexts without the need for expert knowledge in data collection and analysis, or significant expenditure.

The survey is primarily targeted at senior decision-makers in public institutions with an overview of urban nature governance for a particular city. To gain a more comprehensive picture, and depending on available budget, the survey could be used to seek complementary stakeholder views from academia, private sector (built environment & other) and civil society, including local experts.

Each indicator summarises the essence of the corresponding dimension in one sentence (Table 2). A five-point Likert scale is used to measure the extent to which each indicator is perceived to apply to a specific city, followed by an open-ended question to understand how this has been achieved. After completing all questions related to the individual governance indicators, respondents are asked to order the indicators in relation to perceived importance for NBS governance in their city. The survey can be repeated over time to create an understanding of long-term trends, for example by monitoring the impact of an NBS intervention over time. (Fig. 2).

Table 2
Governance indicators with corresponding item descriptions and measurement scale as used in the survey-based instrument.

#	Governance indicator	Item descriptions	Measurement scale
1	**Agency**	People in powerful positions advocate for more or better NBS in the city	Not at all (1) – To a great extent (5)
2	**Integrated working**	Decision-makers representing different policy domains work in an integrated way to support the planning, design and management of NBS in the city	Not at all (1) – To a great extent (5)
3	**Legislation, regulations and policies**	Public institutions have laws, policies and regulations mandating the planning, design and management of urban NBS	Not at all (1) – To a great extent (5)
4	**Collaborative arrangements**	Multi-stakeholder partnerships supporting NBS in the city	Not at all (1) – To a great extent (5)
5	**Active community engagement**	Community engagement contributes to the planning, design and management of NBS in the city	Not at all (1) – To a great extent (5)
6	**Monitoring and assessment**	Public institutions and other relevant decision-makers support, or engage in, the monitoring and assessment of NBS in the city	Not at all (1) – To a great extent (5)
7	**Knowledge development and sharing**	Public institutions and other relevant decision-makers aim to develop and share a broad knowledge and skills base on urban NBS	Not at all (1) – To a great extent (5)
8	**Financing mechanisms**	Public institutions and other relevant decision-makers have access to, and make use of, effective and diverse financing mechanisms for NBS in the city	Not at all (1) – To a great extent (5)
9	**Valuing diversity, equity and inclusion**	Public institutions and other relevant decision-makers recognise and engage people from diverse backgrounds and with different identities in decision-making on NBS in the city	Not at all (1) – To a great extent (5)

5. Discussion

The aim of this systematic review was to develop an in-depth understanding of the different dimensions of urban NBS governance and how these can be feasibly and comprehensively monitored. First, we built a picture of governance dimensions influencing the successful uptake of urban NBS and the achievement of environmental justice based on a review of the literature (*Research question 1*). Next, we used this as the basis for developing a new urban NBS governance indicator framework using a survey-based approach (*Research question 2*).

We believe that the governance assessment framework elaborated here complements existing NBS assessment frameworks such as the EC Handbook (Dumitru and Wendling, 2021), which are largely geared towards measuring participatory governance based on detailed and/or complex indicators requiring in-depth knowledge of participatory processes. Our research does not refute the assumption that non-hierarchical governance – characterised by high network connectivity, reflexivity and a distribution of decision-making power and resources (Campbell et al., 2016; Schifman et al., 2017) – is associated with successful NBS uptake (Fink et al., 2019; Ibrahim et al., 2020; Workalemahu Habtemariam et al., 2019). However, we contend that there remains a need for top-down coordination to maintain a sufficient level of democratic control over e.g., NBS design and distribution (Mell, 2020a; Toxopeus et al., 2020). Policy frameworks can also help to ensure long-term sustainability of citizen initiatives with delegated

3. Legislation, regulations and policies

3. a)	Do public institutions have policies and regulations mandating the planning, design and management of nature-based solutions in your city?	*Not at all*	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	*To a great extent*
b)	If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: ...							

4. Collaborative arrangements

4. a)	Are you aware of multi-stakeholder partnerships supporting nature-based solutions in your city?	*Not at all*	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	*To a great extent*
b)	If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: ...							

Fig. 2. A snippet from the survey-based instrument to assess urban NBS governance (see Appendix B for the full survey).

decision-making powers (Puskás et al., 2021), demonstrating a need for strategically combining hierarchical steering and participatory processes. A final step is therefore to compare our elaborated indicators to the existing state-of-the-art in assessing urban NBS governance (Section 5.2; *Research question* 3).

In Section 5.1, we will first provide an overview of the dimensions emerging from this review, how these relate to typologies of urban NBS governance enablers described elsewhere, and their interrelationships. In Section 5.2, we then compare our elaborated indicators against related EC handbook indicators and any other governance indicators included in this compendium. This serves to demonstrate the ways in which the elaborated indicators complement the current practice in urban NBS governance assessment. This is followed by a reflection on study limitations and directions for future research in Section 5.3.

5.1. Getting urban NBS to bloom

Fig. 3 depicts the nine dimensions emerging from this review, along with overarching themes (Table 1), as parts of a flower. This metaphor is used to convey how the dimension of Environmental justice relates to the governance themes (encompassing the governance dimensions) and its contribution to the 'blooming' of urban NBS. *Environmental justice* is positioned in the stalk of the flower as diverse needs and perspectives should be recognised and incorporated in governance practices to create good alignment between NBS and the needs and preferences of various social groups (Langemeyer and Connolly, 2020). The inclusion of environmental justice is unlike most related governance typologies, although Lawrence et al. (2013) call for a power analysis of involved stakeholders as part of their urban forest governance framework.

Agency refers to efforts aimed at the formation of alternative collective storylines, or counter-discourses, that influence the construction and/or deconstruction of formal and informal institutions guiding real-world practices (Arts, 2021; Buijs et al., 2014). Corresponding with neo-institutional theory, agency is predicted by an actor's social position along with their specific qualities and abilities, which influences the propensity for their standards of practice to be transferred and reproduced across different scales (Fuenfschilling, 2019; T. B. Lawrence, 1999). Agents in less powerful positions can, however, also exert

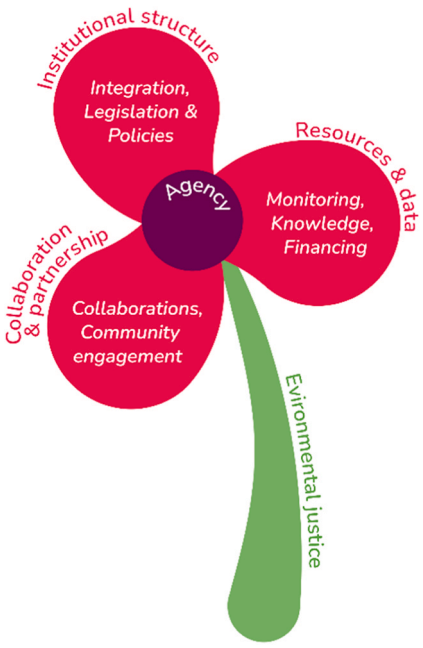


Fig. 3. Visualisation of the governance themes, governance dimensions (with abbreviated descriptions for graphic design purposes) and their interrelationships. Image credit: Gabriela Carrasco Puga.

significant leverage as they are less strongly embedded in prevailing discourses or institutional logics (Fuenfschilling, 2019). We therefore consider *Agency* to be at the core of urban NBS governance, involving a supportive institutional structure, partnership working, resources and data as well as environmental justice (Fig. 3). Martin et al. (2021) previously also referred to the need for local champions in their overview of NBS enablers, while executive leadership is part of the framework by Croeser et al. (2021).

The remaining dimensions – *Legislation, regulations and policies*; *Collaborative arrangements*; *Active community engagement*; *Monitoring and*

assessment; *Knowledge development and sharing*; and.

Financing mechanisms are visualised in the flower petals as aspects central to common understandings of urban NBS and urban forests (A. Lawrence et al., 2013; Martin et al., 2021; Sarabi et al., 2019). For example, Sarabi et al. (2019) found that: "Developing partnerships between stakeholders appears to be the most frequently observed enabler [of NBS], followed by effective monitoring, knowledge sharing, financial instruments, plans and legislations, education and training, combining with gray infrastructures, open innovation and experimentation, and appropriate planning and design" (p.15). In agreement with Lawrence et al. (2013), who described Participation and Partnerships as two separate dimensions, the role of citizen engagement is singled out in our framework, which is unlike the governance enablers uncovered by Martin et al. (2021) and Sarabi et al. (2019). Our framework also distinguishes sub-dimensions such as reflexive social learning processes and environmental education aimed at the public, which receive little to no comment in previous urban NBS governance reviews.

5.2. A feasible and comprehensive approach to governance assessment

We contend that the governance assessment framework presented in Section 4.2 complements the EC Handbook indicators, considering both its recommended and additional indicators, representing the state-of-the-art in NBS assessment (Dumitru & Wendling, 2021). To evidence this, the main investigator compared all EC Handbook indicators related to governance (name, description, measurement procedure, required data) with the elaborated governance indicators and recorded any discrepancies in scope and measurement procedure for seemingly similar or overlapping indicators (Appendix C). We found that the elaborated indicators varied in important respects from the EC Handbook indicators. Notably, the *Agency* and *Monitoring and assessment* indicators elaborated in this review do not have obvious counterparts in the EC Handbook, thus providing an extension to its approach of assessing NBS governance. Moreover, three of our indicators have a broader scope than related indicators in the EC Handbook. First, the *Integrated working* indicator is related to the 'strategic alignment' indicator in the EC Handbook, but the latter arguably has a narrow focus on strategic alignment of NBS within the urban municipality's agenda and investment portfolio whilst our indicator considers attempts to integrate and streamline decision-making on the planning, design and management of NBS. Likewise, our *Legislation, regulations and policies* indicator has a wider remit than the two EC Handbook indicators based around the implementation of a very specific type of strategy (climate resilience strategy). Similarly, the scope of the *Financing mechanisms* indicator goes beyond its EC Handbook counterpart, which only measures new forms of financing, not the role of core funding and its effectiveness in supporting NBS.

In other areas, related to our indicators for *Active community engagement*, *Collaborative arrangements*, and *Knowledge development and sharing*, the EC Handbook provides relatively more coverage than for its other indicators. Although the EC Handbook includes multiple indicators for each of these dimensions, they can be framed rather narrowly. For example, the seven EC Handbook indicators for *Active community engagement* vary from measuring percentages of citizens actively engaged in NBS projects to their involvement in planning or implementation rated on a fixed-point scale. The number of indicators in our framework is lower and therefore likely less resource-demanding to work with, but at the same time this also offers less flexibility for selecting individual indicators suited to the researchers' needs. For example, the EC Handbook's 'green intelligence awareness' indicator is a useful measure of different types of environmental education. The EC Handbook also offers comprehensive social learning indicators – capturing the influence of NBS projects on policies, instruments or regulations introduced, along with effects on working practices and discourses. Unlike our city-scale framework, the EC Handbook also provides some indicators that can be used at the level of individual NBS projects or communities, e.g., related to the degree of participation and stakeholder groups involved NBS initiatives.

The ten EC Handbook indicators overlapping with our *Valuing diversity, equity and inclusion* dimension include various measures of procedural justice, mainly scrutinising the involvement of various groups, including underrepresented actors, in NBS projects. Also included are indicators on fairness and transparency of the process and various quantitative indicators related to distributional justice, albeit not necessarily categorised as such: accessibility on foot, access for disadvantaged groups and property value effects of NBS. Whilst this affords a more detailed, in-depth, flexible and systematic analysis of environmental justice compared to our single indicator on this domain, there are no EC Handbook dimensions for recognition justice, crucial to appreciating the relationship between governance and environmental justice outcomes (Fig. 3; Langemeyer and Connolly, 2020).

A balanced and, overall, comprehensive set of indicators for urban NBS governance is a key contribution of this review. However, our survey-based instrument for measuring NBS governance has the potential to advance urban NBS governance assessment in other ways too. First, our indicator set does not require specialist expertise in assessment or analysis or the expense of considerable time or monetary resources to complete, enabling a broad range of decision-makers to use these indicators. This is a key achievement given the multi-scale and multi-domain character of urban NBS governance (Dorst et al., 2022; Tozer et al., 2022; van der Jagt, Tozer, et al., 2023), meaning that actors from a range of disciplines and sectors – governments, urban developers, investors, community groups, knowledge workers, etc. – should ideally be consulted. Second, we consider environmental justice as a dimension underpinning the other governance dimensions and thus included it in our governance assessment framework. For example, knowledge development and sharing are unlikely to lead to NBS mainstreaming if the knowledge of some groups and communities is excluded. This is unlike many previous assessment frameworks where the engagement of people from different backgrounds and identities is not considered as part of governance assessment.

5.3. Limitations and directions for future research

One of the goals of this review was to provide a feasible and comprehensive approach to urban NBS governance assessment. To achieve this, we aimed to keep the number of indicators to a minimum, whilst still covering the full spectrum of identified governance dimensions. As a result, our framework is less flexible and suited for in-depth analysis of some governance dimensions than the EC Handbook and other assessment frameworks. To address this, complementary indicators could be selected from existing assessment frameworks for monitoring e.g., individual sites or more specific governance aspects. Another potential research avenue is to develop additional indicators for each of the sub-dimensions in our framework (Table 2), adding five more indicators. Impacts on the time burden for survey participants should, however, be carefully considered. A third option could be to develop new indicators for aspects currently underrepresented in urban NBS governance research. We identified at least two knowledge gaps related to strategic planning and the integration of traditional and/or indigenous knowledge, as discussed below.

Green space planning and management have been acknowledged in many assessment frameworks as a challenge and opportunity, yet most indicators related to planning focus on the outcomes and impacts of planning on the physical environment and less on the planning process (e.g., Dumitru and Wendling, 2021). An example of such a distinctive planning feature supporting the implementation of NBS, particularly green infrastructure, is strategic planning (Hansen et al., 2019; Pauleit et al., 2019; Vaňo et al., 2021). To steer future development of NBS, long-term goals or future visions are developed, which address broad overarching themes spanning disciplinary boundaries. Despite their broadness, these goals and vision would help to prioritise actions

(Wiechmann, 2008). Strategic planning is frequently combined with an incremental process of defining the short-term and intermediate steps towards achieving the long-term shared goals or vision, which could bring the formal practices, policies and unplanned informal bottom-up initiatives together (Buijs et al., 2019; Wiechmann, 2008).

Related to the global ambitions around urban NBS and its assessment, we identify a second knowledge gap in the governance literature on traditional and/or indigenous knowledge. Whilst our indicators, as well as those from the EC Handbook, aim to recognise the need to incorporate local values and knowledges from a global perspective, traditional ecological knowledge (TEK) seems somewhat overlooked. The IUCN describes a "good governance process" as one that requires all stakeholder groups, including traditionally excluded groups (e.g., indigenous peoples and local communities) to take part into an "inclusive, transparent and empowering governance process" (IUCN, 2020, p.14). Several studies report on practices supporting this premise by incorporating traditional knowledge into policies and measures for the effective management of biodiversity (Dearden et al., 2017; Folke, 2004). However, indicators on use of TEK are not part of the EC Handbook, likely resulting a lack of knowledge by decision-makers on pathways to include it. In their systematic review on the conservation outcomes of different modes of governance, Dawson et al. (2021, "Discussion," para. 4) conclude that "research approaches applied to conservation must, at a minimum, be appropriately designed to explore IPLCs' [Indigenous peoples and local communities'] knowledge, institutions, and the viability of local stewardship of the environment as a pathway to sustainability". Although the indicator on *Valuing diversity, equity and inclusion* goes some way towards doing so, we recommend the development of a specific indicator on the use of capturing and using TEK.

Finally, it should be noted that our indicators, relying on self-reports, might not be understood in the same way by practitioners across various sectors and geographical contexts. To ease interpretation, it is important to present the survey rubric along with the questions. Further testing of the survey and its reliability in measuring the various governance dimensions is needed to refine the questions and rubrics.

6. Conclusions

Nature-based solutions (NBS) are now widely considered as important in addressing major urbanisation challenges. Many urban NBS have been documented and insights are readily available, e.g., via the EU Oppla platform (https://oppla.eu/). Yet, mainstreaming urban NBS remains an important challenge. Wider implementation and mainstreaming of NBS not only depends on assessing its impact, but also on understanding the critical governance drivers and barriers. As governance is often complex and multi-layered, governance indicators need to include different modes of governance, from top-down planning approaches to civil society initiatives. These considerations are not convincingly addressed in existing frameworks, such as the EC Handbook for Evaluating the Impact of Nature-Based Solutions (Dumitru and Wendling, 2021). This study has made an important step to closing this knowledge gap. Grounded in a systematic review, a framework of five themes was developed, encompassing nine dimensions, some with sub-dimensions, that can be assessed with a survey-based instrument introduced in this paper. The novelty of our governance assessment framework is in encapsulating different modes of governance and affording a low-cost, feasible format for assessment, not requiring high-level expertise in data collection and analysis. Moreover, the framework recognises the important role of governance arrangements between government and civil society actors in NBS, whilst also considering the need for leadership commitment and agency on urban NBS. Furthermore, we integrate a measure of environmental justice to highlight the need for considering interactions with diverse perspectives and practices when evaluating the governance components of urban NBS.

The identified knowledge gaps on strategic planning and community-based knowledge in the urban NBS governance literature suggest that the comprehensiveness of this governance assessment framework likely can be further improved. However, researchers should endeavour to maintain assessment feasibility by restricting the number of indicators in the survey. This will likely boost response rates and quality of responses – important to accessing the views of a range of stakeholders on the governance indicators. These issues will be explored further by applying the framework in four Latin American and three European cities, representing socio-economically and culturally diverse settings.

Funding

This research has been funded by the European Commission's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 867564 and participating partners in the CONEXUS Project.

CRediT authorship contribution statement

Alexander van der Jagt: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Arjen Buijs:** Conceptualization, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Cynnamon Dobbs:** Funding acquisition, Writing – original draft, Writing – review & editing. **Martina van Lierop:** Project administration, Writing – original draft, Writing – review & editing. **Stephan Pauleit:** Funding acquisition, Project administration, Writing – review & editing. **Thomas Randrup:** Writing – original draft, Writing – review & editing. **Andrea Skiba:** Writing – original draft, Writing – review & editing. **Tom Wild:** Funding acquisition. Project administration, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We thank all researchers and practitioners involved in the Horizon 2020 CONEXUS research project funding this review, particularly the reviewers of the survey-based instrument. We are grateful to Gabriela Carrasco Puga for graphical design and to two anonymous practitioners for piloting the indicators.

Appendix A. Final selection of publications included in the review

#	Reference
1	Ahmed, S., Meenar, M., & Alam, A. (2019). Designing a Blue-Green Infrastructure (BGI) Network: Toward Water-Sensitive Urban Growth Planning in Dhaka, Bangladesh. *Land*, *8*(138).
2	Andersson, E. (2018). Functional landscapes in cities: A systems approach. *Landscape and Ecological Engineering*, *14*, 193–199. https://doi.org/10.1007/s11355–017–0346–6
3	Andersson, E., Barthel, S., Borgström, S., Colding, J., Elmqvist, T., Folke, C., & Gren, Å. (2014). Reconnecting cities to the biosphere: Stewardship of green infrastructure and urban ecosystem services. *Ambio*, *43*(4), 445–453. https://doi.org/10.1007/s13280–014–0506-y
4	Andersson, K., Angelstam, P., Elbakidze, M., Axelsson, R., & Degerman, E. (2013). Green infrastructures and intensive forestry: Need and opportunity for spatial planning in a Swedish rural–urban gradient. *Scandinavian Journal of Forest 5Research*, *28*(2), 143–165. https://doi.org/10.1080/02827581.2012.723740
5	Assmuth, T., Hellgren, D., Kopperoinen, L., Paloniemi, R., & Peltonen, L. (2017). Fair blue urbanism: Demands, obstacles, opportunities and knowledge needs for just recreation beside Helsinki Metropolitan Area waters. *International Journal of Urban Sustainable Development*, *9*(3), 253–273. https://doi.org/10.1080/19463138.2017.1370423
6	Aubrechtová, T., Semančíková, E., & Raška, P. (2020). Formulation matters! The failure of integrating landscape fragmentation policy. *Sustainability*, *12*, 3962. https://doi.org/10.3390/SU12103962
7	BenDor, T. K., Shandas, V., Miles, B., Belt, K., & Olander, L. (2018). Ecosystem services and U.S. stormwater planning: An approach for improving urban stormwater decisions. *Environmental Science and Policy*, *88*, 92–103. https://doi.org/10.1016/j.envsci.2018.06.006
8	Benton-Short, L., Keeley, M., & Rowland, J. (2019). Green infrastructure, green space, and sustainable urbanism: Geography's important role. *Urban Geography*, *40*(3), 330–351. https://doi.org/10.1080/02723638.2017.1360105
9	Buijs, A. E., Mattijssen, T. J., Van der Jagt, A. P. N., Ambrose-Oji, B., Andersson, E., Elands, B. H., & Steen M?ller, M. (2016). Active citizenship for urban green infrastructure: Fostering the diversity and dynamics of citizen contributions through mosaic governance. *Current Opinion in Environmental Sustainability*, *22*, 1–6.
10	Buijs, A., Hansen, R., van der Jagt, A. P. N., Ambrose-Oji, B., Elands, B., Lorance Rall, E., Mattijssen, T., Pauleit, S., Runhaar, H., Stahl Olafsson, A., & Steen Møller, M. (2019). Mosaic governance for urban green infrastructure: Upscaling active citizenship from a local government perspective. *Urban Forestry & Urban Greening*, *40*, 53–62. https://doi.org/10.1016/j.ufug.2018.06.011
11	Campbell, L. K., Svendsen, E. S., & Roman, L. A. (2016). Knowledge Co-production at the Research–Practice Interface: Embedded Case Studies from Urban Forestry. *Environmental Management*, *57*, 1262–1280. https://doi.org/10.1007/s00267–016–0680–8
12	Campbell-Arvai, V., & Lindquist, M. (2021). From the ground up: Using structured community engagement to identify objectives for urban green infrastructure planning. *Urban Forestry & Urban Greening*, *59*, 127013. https://doi.org/10.1016/j.ufug.2021.127013
13	Clark, C., Ordóñez, C., & Livesley, S. J. (2020). Private tree removal, public loss: Valuing and enforcing existing tree protection mechanisms is the key to retaining urban trees on private land. *Landscape and Urban Planning*, *203*, 103899. https://doi.org/10.1016/j.landurbplan.2020.103899
14	Coenen, F. H. J. M. (2009). *Public participation and better environmental decisions: The promise and limits of participatory processes for the quality of environmentally related decision-making*. Dordrecht: Springer.
15	Cousins, J. J. (2021). Justice in nature-based solutions: Research and pathways. *Ecological Economics*, *180*, 106874. https://doi.org/10.1016/j.ecolecon.2020.106874
16	de Oliveira Fontes, L. (2020). From cultural formation to social mobilization: Spaces for formation and mobilization over three generations in the São Paulo outskirts. *Lua Nova: Revista de Cultura e Política*, *109*, 51–101. https://doi.org/10.1590/0102–051101/109
17	de Vries, S., Buijs, A. E., & Snep, R. P. H. (2020). Environmental Justice in The Netherlands: Presence and Quality of Greenspace Differ by Socioeconomic Status of Neighbourhoods. *Sustainability*, *12*(15), 5889. https://doi.org/10.3390/su12155889
18	Dobbs, C., Escobedo, F. J., Clerici, N., de la Barrera, F., Eleuterio, A. A., MacGregor-Fors, I., Reyes-Paecke, S., Vásquez, A., Camaño, J. D. Z., & Hernández, H. J. (2019). Urban ecosystem Services in Latin America: Mismatch between global concepts and regional realities? *Urban Ecosystems*, *22*, 173–187.
19	Donaldson, G. H., & João, E. M. (2020). Using green infrastructure to add value and assist place-making in public realm developments. *Impact Assessment and Project Appraisal*, *38*(6), 464–478. https://doi.org/10.1080/14615517.2019.1648731
20	Dorst, H., van der Jagt, A. P. N., Raven, R., & Runhaar, H. (2019). Urban greening through Nature-Based Solutions – key characteristics of an emerging concept. *Sustainable Cities and Society*, 101620. https://doi.org/10.1016/j.scs.2019.101620
21	Draus, P., Lovall, S., Formby, T., Baldwin, L., & Lowe-Anderson, W. (2019). A green space vision in Southeast Michigan's most heavily industrialized area. *Urban Ecosystems*, *22*(1), 91–102. https://doi.org/10.1007/s11252–018–0765–7
22	Duinker, P. N., Ordóñez, C., Steenberg, J. W. N., Miller, K. H., Toni, S. A., & Nitoslawski, S. A. (2015). Trees in canadian cities: Indispensable life form for urban sustainability. *Sustainability (Switzerland)*, *7*(6), 7379–7396. https://doi.org/10.3390/su7067379
23	Dushkova, D., & Haase, D. (2020). Not Simply Green: Nature-Based Solutions as a Concept and Practical Approach for Sustainability Studies and Planning Agendas in Cities. *Land*, *9*, 19.
24	Dyca, B., Muldoon-Smith, K., & Greenhalgh, P. (2020). Common value: Transferring development rights to make room for water. *Environmental Science & Policy*, *114*, 312–320. https://doi.org/10.1016/j.envsci.2020.08.017
25	Fan, P., Ouyang, Z., Basnou, C., Pino, J., Park, H., & Chen, J. (2017). Nature-based solutions for urban landscapes under post-industrialization and globalization: Barcelona versus Shanghai. *Environmental Research*, *156*, 272–283. https://doi.org/10.1016/j.envres.2017.03.043
26	Ferguson, M., Roberts, H. E., McEachan, R. R. C., & Dallimer, M. (2018). Contrasting distributions of urban green infrastructure across social and ethno-racial groups. *Landscape and Urban Planning*, *175*, 136–148. https://doi.org/10.1016/j.landurbplan.2018.03.020
27	Ferreira, V., Barreira, A. P., Antunes, D., & Panagopoulos, T. (2020). Stakeholders' Engagement on Nature-Based Solutions: A Systematic Literature Review. *Sustainability*, *12*, 640.
28	Finewood, M. H., Matsler, A. M., & Zivkovich, J. (2019). Green Infrastructure and the Hidden Politics of Urban Stormwater Governance in a Postindustrial City. *Annals of the American Association of Geographers*, *109*(3), 909–925. https://doi.org/10.1080/24694452.2018.1507813
29	Fink, J. H. (2019). Contrasting governance learning processes of climate-leading and -lagging cities: Portland, Oregon, and Phoenix, Arizona, USA. *Journal of Environmental Policy & Planning*, *21*(1), 16–29. https://doi.org/10.1080/1523908X.2018.1487280
30	Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. *Environmental Science and Policy*, *93*, 101–111. https://doi.org/10.1016/j.envsci.2018.12.033
31	Frantzeskaki, N., McPhearson, T., & Kabisch, N. (2021). Urban sustainability science: Prospects for innovations through a system's perspective, relational and transformations' approaches: This article belongs to Ambio's 50th Anniversary Collection. Theme: Urbanization. *Ambio*, *50*(9), 1650–1658. https://doi.org/10.1007/s13280–021–01521–1
32	Gabriel, N. (2016). "No place for wilderness": Urban parks and the assembling of neoliberal urban environmental governance. *Urban Forestry and Urban Greening*, *19*, 278–284. https://doi.org/10.1016/j.ufug.2016.02.006
33	Gould, K. A., & Lewis, T. L. (2017). *Green Gentrification: Urban Sustainability and the Struggle for Environmental Justice*. Routledge.
34	Gulsrud, N. M., Hertzog, K., & Shears, I. (2018). Innovative urban forestry governance in Melbourne? Investigating "green placemaking" as a nature-based solution. *Environmental Research*, *161*, 158–167. https://doi.org/10.1016/j.envres.2017.11.005
35	Gulsrud, N. M., Raymond, C. M., Rutt, R. L., Olafsson, A. S., Plieninger, T., Sandberg, M., Beery, T. H., & Jönsson, K. I. (2018). 'Rage against the machine'? The opportunities and risks concerning the automation of urban green infrastructure. *Landscape and Urban Planning*, *180*, 85–92. https://doi.org/10.1016/j.landurbplan.2018.08.012
36	Haase, D., Kabisch, S., Haase, A., Andersson, E., Banzhaf, E., Baró, F., Brenck, M., Fischer, L. K., Frantzeskaki, N., Kabisch, N., Krellenberg, K., Kremer, P., Kronenberg, J., Larondelle, N., Mathey, J., Pauleit, S., Ring, I., Rink, D., Schwarz, N., & Wolff, M. (2017). Greening cities – To be socially inclusive? About the alleged paradox of society and ecology in cities. *Habitat International*, *64*, 41–48. https://doi.org/10.1016/j.habitatint.2017.04.005
37	Hazrati, M., & Heffron, R. J. (2021). Conceptualising restorative justice in the energy Transition: Changing the perspectives of fossil fuels. *Energy Research & Social Science*, *78*, 102115. https://doi.org/10.1016/j.erss.2021.102115
38	Herslund, L., & Mguni, P. (2019). Examining urban water management practices – Challenges and possibilities for transitions to sustainable urban water management in Sub-Saharan cities. *Sustainable Cities and Society*, *48*, 101573. https://doi.org/10.1016/j.scs.2019.101573

(*continued on next page*)

(*continued*)

#	Reference
39	Hobbie, S. E., & Grimm, N. B. (2020). Nature-based approaches to managing climate change impacts in cities. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *375*(1794), 20190124. https://doi.org/10.1098/rstb.2019.0124
40	Ibrahim, A., Bartsch, K., & Shari, E. (2020). Green infrastructure needs green governance: Lessons from Australia's largest integrated stormwater management project, the River Torrens Linear Park. *Journal of Cleaner Production*, *261*, 121202. https://doi.org/10.1016/j.jclepro.2020.121202
41	Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., Knapp, S., Korn, H., Stadler, J., Zaunberger, K., & Bonn, A. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: Perspectives on indicators, knowledge gaps, barriers, and opportunities for action. *Ecology and Society*, *21* (2), 39.
42	Kazak, J. K., Chruściński, J., & Szewrański, S. (2018). The development of a novel decision support system for the location of green infrastructure for stormwater management. *Sustainability*, *10*, 4388. https://doi.org/10.3390/su10124388
43	Kloek, M. E., Buijs, A. E., Boersema, J. J., & Schouten, M. G. C. (2013). Crossing Borders: Review of Concepts and Approaches in Research on Greenspace, Immigration and Society in Northwest European Countries. *Landscape Research*, *38*(1), 117–140. https://doi.org/10.1080/01426397.2012.690861
44	Kordana, S., & Daniel, S. (2020). An analysis of important issues impacting the development of stormwater management systems in Poland. *Science of the Total Environment*, *727*, 138711. https://doi.org/10.1016/j.scitotenv.2020.138711
45	Kowarik, I. (2019). The "Green Belt Berlin": Establishing a greenway where the Berlin Wall once stood by integrating ecological, social and cultural approaches. *Landscape and Urban Planning*, *184*, 12–22. https://doi.org/10.1016/j.landurbplan.2018.12.008
46	Kuller, M., Bach, P. M., Roberts, S., Browne, D., & Deletic, A. (2019). A planning-support tool for spatial suitability assessment of green urban stormwater infrastructure. *Science of the Total Environment*, *686*, 856–868. https://doi.org/10.1016/j.scitotenv.2019.06.051
47	Kvamsås, H. (2021). Addressing the adaptive challenges of alternative stormwater planning. *Journal of Environmental Policy & Planning*, 1–13. https://doi.org/10.1080/1523908X.2021.1921568
48	Langemeyer, J., Camps-Calvet, M., Calvet-Mir, L., Barthel, S., & Gómez-Baggethun, E. (2018). Stewardship of urban ecosystem services: Understanding the value(s) of urban gardens in Barcelona. *Landscape and Urban Planning*, *170*, 79–89. https://doi.org/10.1016/j.landurbplan.2017.09.013
49	Langemeyer, J., & Connolly, J. J. T. (2020). Weaving notions of justice into urban ecosystem services research and practice. *Environmental Science & Policy*, *109*, 1–14. https://doi.org/10.1016/j.envsci.2020.03.021
50	Larson, K. L., Wiek, A., & Withycombe, L. (2013). A comprehensive sustainability appraisal of water governance in Phoenix, AZ. *Journal of Environmental Management*, *116*, 58–71. https://doi.org/10.1016/j.jenvman.2012.11.016
51	Li, L., Collins, A. M., Cheshmehzangi, A., & Chan, F. K. S. (2020). Identifying enablers and barriers to the implementation of the Green Infrastructure for urban flood management: A comparative analysis of the UK and China. *Urban Forestry and Urban Greening*, *54*, 126770. https://doi.org/10.1016/j.ufug.2020.126770
52	Lin, B. B., Meyers, J. A., & Barnett, G. B. (2019). Establishing Priorities for Urban Green Infrastructure Research in Australia. *Urban Policy and Research*, *37*(1), 30–44. https://doi.org/10.1080/08111146.2018.1523054
53	Meerow, S., & Newell, J. P. (2019). Urban resilience for whom, what, when, where, and why? *Urban Geography*, *40*(3), 309–329. https://doi.org/10.1080/02723638.2016.1206395
54	Mell, I. (2020a). The impact of austerity on funding green infrastructure: A DPSIR evaluation of the Liverpool Green & Open Space Review (LG&OSR), UK. *Land Use Policy*, *91*. https://doi.org/10.1016/j.landusepol.2019.104284
55	Mell, I. (2020b). What Future for Green Infrastructure Planning? Evaluating the Changing Environment for Green Infrastructure Planning Following the Revocation of Regional Planning Policy in England. *Planning Practice & Research*, *35*(1), 18–50. https://doi.org/10.1080/02697459.2020.1714271
56	Mguni, P., Herslund, L., & Bergen, M. (2016). Sustainable urban drainage systems: Examining the potential for green infrastructure-based stormwater management for Sub-Saharan cities. *Natural Hazards*, *82*(2), 241–257. https://doi.org/10.1007/s11069–016–2309-x
57	Mguni, P., Herslund, L., & Jensen, M. B. (2015). Green infrastructure for flood-risk management in Dar es Salaam and Copenhagen: Exploring the potential for transitions towards sustainable urban water management. *Water Policy*, *17*(1), 126–142. https://doi.org/10.2166/wp.2014.047
58	Nastran, M., & Regina, H. (2016). Advancing urban ecosystem governance in Ljubljana. *Environmental Science & Policy*, *62*, 123–126. https://doi.org/10.1016/j.envsci.2015.06.003
59	Nesbitt, L., Meitner, M. J., Sheppard, S. R. J., & Girling, C. (2018). The dimensions of urban green equity: A framework for analysis. *Urban Forestry & Urban Greening*, *34*, 240–248. https://doi.org/10.1016/j.ufug.2018.07.009
60	Nielsen, A. B., Hedblom, M., Olafsson, A. S., & Wiström, B. (2017). Spatial configurations of urban forest in different landscape and socio-political contexts: Identifying patterns for green infrastructure planning. *Urban Ecosystems*, *20*(2), 379–392. https://doi.org/10.1007/s11252–016–0600-y
61	O'Donnell, E. C., Lamond, J. E., & Thorne, C. R. (2018). Learning and Action Alliance framework to facilitate stakeholder collaboration and social learning in urban flood risk management. *Environmental Science and Policy*, *80*, 1–8. https://doi.org/10.1016/j.envsci.2017.10.013
62	O'Donnell, E., Netusil, N., Chan, F., Dolman, N., & Gosling, S. (2021). International Perceptions of Urban Blue-Green Infrastructure: A Comparison across Four Cities. *Water*, *13* (4), 544. https://doi.org/10.3390/w13040544
63	Ordóñez, C., Threlfall, C. G., Kendal, D., Hochuli, D. F., Davern, M., Fuller, R. A., van der Ree, R., & Livesley, S. J. (2019). Urban forest governance and decision-making: A systematic review and synthesis of the perspectives of municipal managers. *Landscape and Urban Planning*, *189*, 166–180. https://doi.org/10.1016/j.landurbplan.2019.04.020
64	Pasimeni, M. R., Valente, D., Zurlini, G., & Petrosillo, I. (2019). The interplay between urban mitigation and adaptation strategies to face climate change in two European countries. *Environmental Science & Policy*, *95*, 20–27. https://doi.org/10.1016/j.envsci.2019.02.002
65	Pauleit, S., Ambrose-Oji, B., Andersson, E., Anton, B., Buijs, A., Haase, D., Elands, B., Hansen, R., Kowarik, I., Kronenberg, J., Mattijssen, T., Stahl Olafsson, A., Rall, E., van der Jagt, A. P. N., & Konijnendijk van den Bosch, C. (2019). Advancing urban green infrastructure in Europe: Outcomes and reflections from the GREEN SURGE project. *Urban Forestry and Urban Greening*, *40*, 4–16. https://doi.org/10.1016/j.ufug.2018.10.006
66	Pineda-Pinto, M., Frantzeskaki, N., & Nygaard, C. A. (2022). The potential of nature-based solutions to deliver ecologically just cities: Lessons for research and urban planning from a systematic literature review. *Ambio*, *51*, 167–182. https://doi.org/10.1007/s13280–021–01553–7
67	Reed, M. S., Vella, S., Challies, E., de Vente, J., Frewer, L., Hohenwallner-Ries, D., Huber, T., Neumann, R. K., Oughton, E. A., Sidoli del Ceno, J., & van Delden, H. (2018). A theory of participation: What makes stakeholder and public engagement in environmental management work? A theory of participation. *Restoration Ecology*, *26*, S7–S17. https://doi.org/10.1111/rec.12541
68	Rogers, B. C., Dunn, G., Hammer, K., Novalia, W., de Haan, F. J., Brown, L., Brown, R. R., Lloyd, S., Urich, C., Wong, T. H. F., & Chesterfield, C. (2020). Water Sensitive Cities Index: A diagnostic tool to assess water sensitivity and guide management actions. *Water Research*, *186*, 116411. https://doi.org/10.1016/j.watres.2020.116411
69	Sarabi, S. E., Han, Q., Romme, A. G. L., de Vries, B., & Wendling, L. (2019). Key enablers of and barriers to the uptake and implementation of nature-based solutions in urban settings: A review. *Resources*, *8*, 121. https://doi.org/10.3390/resources8030121
70	Schäffler, A., & Swilling, M. (2013). Valuing green infrastructure in an urban environment under pressure—The Johannesburg case. *Ecological Economics*, *86*, 246–257. https://doi.org/10.1016/j.ecolecon.2012.05.008
71	Schifman, L. A., Herrmann, D. L., Shuster, W. D., Ossola, A., Garmestani, A., & Hopton, M. E. (2017). Situating Green Infrastructure in Context: A Framework for Adaptive Socio-Hydrology in Cities. *Water Resources Research*, *53*(10), 10139–10154. https://doi.org/10.1002/2017WR020926
72	Shih, W.-Y., Mabon, L., & Puppim de Oliveira, J. A. (2020). Assessing governance challenges of local biodiversity and ecosystem services: Barriers identified by the expert community. *Land Use Policy*, *91*, 104291. https://doi.org/10.1016/j.landusepol.2019.104291
73	Shkaruba, A., Skryhan, H., Likhacheva, O., Katona, A., Maryskevych, O., Kireyeu, V., Sepp, K., & Shpakivska, I. (2021). Development of sustainable urban drainage systems in Eastern Europe: An analytical overview of the constraints and enabling conditions. *Journal of Environmental Planning and Management*, 1–24. https://doi.org/10.1080/09640568.2021.1874893
74	Steen Møller, M., Stahl Olafsson, A., Vierikko, K., Sehested, K., Elands, B., Buijs, A., & Konijnendijk van den Bosch, C. C. (2019). Participation through place-based e-tools: A valuable resource for urban green infrastructure governance? *Urban Forestry & Urban Greening*, *40*, 245–253. https://doi.org/10.1016/j.ufug.2018.09.003

(*continued on next page*)

(*continued*)

#	Reference
75	Suleiman, L. (2021). Blue green infrastructure, from niche to mainstream: Challenges and opportunities for planning in Stockholm. *Technological Forecasting and Social Change*, *166*, 120528. https://doi.org/10.1016/j.techfore.2020.120528
76	Tiwary, A., Vilhar, U., Zhiyanski, M., Stojanovski, V., & Dinca, L. (2020). Management of nature-based goods and services provisioning from the urban common: A pan-European perspective. *Urban Ecosystems*, *23*(3), 645–657. https://doi.org/10.1007/s11252–020–00951–1
77	Toxopeus, H., Kotsila, P., Conde, M., Katona, A., van der Jagt, A. P. N., & Polzin, F. (2020). How 'just' is hybrid governance of urban nature-based solutions? *Cities*, *105*, 102839. https://doi.org/10.1016/j.cities.2020.102839
78	Trentanovi, G., Campagnaro, T., Kowarik, I., Munafò, M., Semenzato, P., & Sitzia, T. (2021). Integrating spontaneous urban woodlands into the green infrastructure: Unexploited opportunities for urban regeneration. *Land Use Policy*, *102*, 105221. https://doi.org/10.1016/j.landusepol.2020.105221
79	van der Jagt, A. P. N., Kiss, B., Hirose, S., & Takahashi, W. (2021). Nature-Based Solutions or Debacles? The Politics of Reflexive Governance for Sustainable and Just Cities. *Frontiers in Sustainable Cities*, *2*, 583833. https://doi.org/10.3389/frsc.2020.583833
80	Wamsler, C. (2015). Mainstreaming ecosystem-based adaptation: Transformation toward sustainability in urban governance and planning. *Ecology and Society*, *20*(2). https://doi.org/10.5751/ES-07489–200230
81	Wamsler, C., Luederitz, C., & Brink, E. (2014). Local levers for change: Mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. *Global Environmental Change*, *29*, 189–201. https://doi.org/10.1016/j.gloenvcha.2014.09.008
82	Wamsler, C., Niven, L., Beery, T. H., Bramryd, T., Jönsson, K. I., Osmani, A., Palo, T., & Stålhammar, S. (2016). Operationalizing ecosystem-based adaptation: Harnessing ecosystem services to buffer communities against climate change. *Ecology and Society*, *21*(1).
83	Wamsler, C., Wickenberg, B., Hanson, H., Alkan Olsson, J., Stålhammar, S., Björn, H., Falck, H., Gerell, D., Oskarsson, T., Simonsson, E., Torffvit, F., & Zelmerlow, F. (2020). Environmental and climate policy integration: Targeted strategies for overcoming barriers to nature-based solutions and climate change adaptation. *Journal of Cleaner Production*, *247*, 119154. https://doi.org/10.1016/j.jclepro.2019.119154
84	Wang, Y., van Roon, M., & Knight-Lenihan, S. (2021). Opportunities and challenges in water sensitive industrial development: An Auckland case study, New Zealand. *International Journal of Sustainable Development & World Ecology*, *28*(2), 143–156. https://doi.org/10.1080/13504509.2020.1783717
85	Wild, T., Dempsey, N., & Broadhead, A. T. (2019). Volunteered information on nature-based solutions—Dredging for data on deculverting. *Urban Forestry & Urban Greening*, *40*, 254–263. https://doi.org/10.1016/j.ufug.2018.08.019
86	Workalemahu Habtemariam, L., Byskov Herslund, L., & Mguni, P. (2019). What makes a champion for landscape-based storm water management in Addis Ababa? *Sustainable Cities and Society*, *46*, 101378. https://doi.org/10.1016/j.scs.2018.12.006
87	Zevenbergen, C., Fu, D., & Pathirana, A. (2018). Transitioning to Sponge Cities: Challenges and Opportunities to Address Urban Water Problems. *Water*, *10*(1230). https://doi.org/10.3390/w10091230
88	Zuniga-Teran, A. A., Staddon, C., Vito, L. D., Gerlak, A. K., Ward, S., Schoeman, Y., Hart, A., Booth, G., Staddon, C., Vito, L. D., Gerlak, A. K., Ward, S., Schoeman, Y., Hart, A., & Booth, G. (2020). Challenges of mainstreaming green infrastructure in built environment professions. *Journal of Environmental Planning and Management*, *63*(4), 710–732. https://doi.org/10.1080/09640568.2019.1605890

Appendix B. Survey-based instrument for measuring urban NBS governance

CONEXUS
Urban nature connects us
Conectados por la naturaleza urbana
Conectados pela natureza urbana

.

A survey on the governance of urban nature-based solutions.

This survey was developed by researchers at Wageningen University in the Netherlands, in collaboration with partner institutions in the CONEXUS research project, to assess aspects of urban nature-based solutions governance. **Nature-based solutions (NBS)** is a relatively new concept referring to interventions based on nature that improve urban sustainability. They do so by addressing multiple challenges, such as flood and heat risk, biodiversity loss and social injustice, simultaneously. For example, the creation of a wetland park might contribute to reducing flood risk, provide habitat for wildlife and benefit the health and well-being of visitors and local residents. Other examples of urban NBS include multifunctional urban green infrastructure, urban agriculture, urban forests, urban parks, sustainable urban drainage systems, green roofs and facades and river restoration.

Whereas most cities have at least some metrics in place to assess urban NBS outcomes, we know much less about the process of planning, designing and managing urban NBS in which aspects of governance come into play. This survey was developed to address this knowledge gap. The results will be used by researchers and practitioners participating in the CONEXUS project to build a better picture of possible bottlenecks preventing NBS uptake in cities across Europe and Latin America. The goal of this survey is to better understand and potentially improve decision-making processes on urban NBS, not to compare or rank the performance of cities.

We will ask you about your perception of different aspects of urban NBS governance in your city, together building a comprehensive picture of opportunities and challenges. We will ask you about the following governance dimensions related to the planning, design and management of nature-based solutions:

1. Advocacy
2. Integrated working
3. Legislation, regulations & policies
4. Stakeholder networks and partnerships
5. Active community engagement
6. Monitoring and assessment
7. Knowledge development and sharing

8. Financing mechanisms
9. Valuing diversity, equity and inclusion

We aimed to create a simple survey with response scales that can be completed in a short period of time. However, for each dimension there is an option to provide more detailed background information if relevant and if time allows. A scoring rubric is provided below the survey, providing additional guidance on each of the governance dimensions.

If the concept of nature-based solutions (NBS) is not yet commonly used in your city, please consider other types of multifunctional urban nature, such as green infrastructure, community gardens or wetlands, when completing the survey.

Thank you very much for your participation and support.

Survey .

Background information
1) City/urban region: …
2) Contact name and email: …
3) Job title: …
4) Organization and department (if relevant): …

Governance dimensions			
1. Advocacy			
1. a) Are people in powerful cities advocating for more or better nature-based solutions in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
2. Integrated working			
2. a) Are decision-makers representing different policy domains working in an integrated way to support the planning, design and management of nature-based solutions in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
3. Legislation, regulations and policies			
3. a) Do public institutions have policies and regulations mandating the planning, design and management of nature-based solutions in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
4. Collaborative arrangements			
4. a) Are you aware of multi-stakeholder partnerships supporting nature-based solutions in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
5. Active community engagement			
5. a) Does community engagement play a role in the planning, design and management of nature-based solutions in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
6. Monitoring and assessment			
6. a) Do public institutions and other relevant decision-makers support, or engage in, the monitoring and assessment of nature-based solutions in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
7. Knowledge development and sharing			

(*continued on next page*)

(*continued*)

7. a) Do public institutions and other relevant decision-makers aim to develop and share a broad knowledge and skills base on nature-based solutions in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
8. Financing mechanisms			
8. a) Do public institutions and other relevant decision-makers have access to, and make use of, effective and diverse financing mechanisms for nature-based solutions in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
9. Valuing diversity, equity and inclusion			
9. a) Do public institutions and other relevant decision-makers recognize and engage people from diverse backgrounds and with different identities in decision-making on NBS in your city?	*Not at all*	1 2 3 4 5 ☐☐☐☐☐	*To a great extent*
a) If answered 3 or higher, please describe how this has been achieved by referring to particular actions taken: .			
11. Could you rank the XX dimensions covered in questions 1–10 in order of importance regarding the governance of NBS in your city (1 = most important; 9 = least important)?			

Governance dimension	**Rank (1–9)**
Advocacy	
Integrated working	
Legislation, regulations and policies	
Networks and partnerships	
Active community engagement	
Monitoring and assessment	
Knowledge development and sharing	
Financing mechanisms	
Valuing diversity, equity and inclusion	

Scoring rubric.

Below, we provide short descriptions for each of the governance dimensions. These can be used as background information to improve the interpretation of questions.

Advocacy (Question 1 A):

Not at all (score=1): There are no people in leadership roles acting as advocates for urban NBS. There is no supportive environment for staff and non-governmental actors aiming to get NBS higher on the agendas of decision-makers.

Moderately (score=3): There is a small number of people in powerful positions influencing urban development that endorse urban NBS, but many others do not, or support for NBS is not persistent over time. Several non-governmental actors and support staff also show a commitment to urban NBS development, and their efforts are acknowledged and incentivized by senior staff or political leaders.

To a great extent (score=5): NBS are persistently championed by a range of actors in leadership positions at different institutions relevant to the city, such as by co-developing a vision on NBS with stakeholders, implementing demonstration projects and supporting others to develop NBS. There are examples of high-impact activities supporting urban NBS by other organizations and individuals too, including lobbying and public outreach. NBS advocates can relate to, and bring together, a broad set of disciplines and stakeholders to strengthen support for NBS.

Integrated working (question 2 A):

Not at all (score=1): NBS are only considered viable measures by a small number of staff operating within a single department of the public institution(s) responsible for this. Other departments and networks are not clearly contributing to NBS planning, design and management. Key plans and policies relevant to urban NBS, e.g., climate action, health promotion, green economy, social justice and biodiversity, are not aligned with each other.

Moderately (score=3): Public institutions have clearly more power to develop NBS in the city than (networks of) practitioners and citizens, or the other way around. Multiple departments support the NBS planning, design and management, but they do not tend to collaborate in strategic ways. Therefore, plans and policies relevant to NBS, e.g., on climate action, health promotion, green economy, social justice and biodiversity, remain poorly aligned.

To a great extent (score=5): NBS in the city are developed by public institutions as well as (networks of) practitioners and citizens. Decision-makers representing different policy domains work together in strategic ways to support NBS planning, design and management, for example in a multidisciplinary hub. NBS are being promoted by multiple well-aligned plans and policies, and associated resources, for their contributions to e.g., climate action, health promotion, the green economy, social justice and biodiversity enhancement.

Legislation, regulations and policies (question 3 A):

Not at all (score=1): There are no or limited regulations ensuring multifunctional NBS are integrated in urban development whilst existing NBS are inadequately protected against infringement by urban development. Existing regulations are inadequately enforced. There are no requirements for NBS with regard to new urban development projects and no ambitions by local or higher levels of government to invest in NBS or to improve NBS investment condition, nature-inclusive working practices and management systems.

Moderately (score=3): There are some regulations prompting housing, infrastructure and/or utilities to co-invest in NBS within the city, but these tend to be monofunctional or not managed well. Existing NBS are not always adequately protected through planning frameworks or

enforcement. There are some plans or policies directly supportive of urban NBS planning, design and/or management or improved NBS investment conditions, nature-inclusive working practices and natural resource management systems, but there is clear scope for improvement.

To a great extent (score=5): Regulations mandate housing, infrastructure and/or utilities to co-invest in NBS within the city. Existing NBS are adequately protected through planning frameworks and regulations are actively enforced. There is an adequate number of government plans or policies directly supportive of urban NBS planning, design and management, whilst also contributing to improved NBS investment conditions, nature-inclusive working practices and natural resource management systems.

Networks and partnerships (question 4 A):

Not at all (score=1): The city lacks networks supporting NBS development or these do not manage to influence practices in a meaningful way, e.g., because of poor coordination. There is no cross-scale collaboration on e.g., aligning green infrastructure planning with the city region.

Moderately (score=3): The city is home to networks supporting NBS development, but these do not manage to engage a broad range of stakeholders from (local) government, the private sector, academia and civil society. There have been efforts to collaborate with actors from higher scales and different jurisdictions, e.g., around green infrastructure planning, but with limited success rates. Partnerships usually lack professional coordination, limiting openness to various perspectives, social learning and member satisfaction.

To a great extent (score=5): The city is home to cross-disciplinary networks supporting NBS development, together mobilising a broad range of stakeholders from (local) government, the private sector, academia and civil society in sharing and coordinating resources. Some of these partnerships include actors from higher scales and different jurisdictions, e.g., around green infrastructure planning. Partnerships are coordinated professionally to ensure openness to various perspectives, social learning and member satisfaction.

Active community engagement (question 5 A):

Not at all (score=1): There is no citizen engagement in the planning, design and implementation of NBS in the city, beyond passive consultation on NBS plans and projects with relatively poor participation. Local NBS initiatives are not supported with funding, expertise or guidance. There are no attempts to use citizen science for the crowdsourcing of socio-ecological data.

Moderately (score=3): A few groups of citizens are actively contributing to the planning, design and implementation of NBS in the city, including their monitoring and maintenance. There is a small number of local initiatives with permission to use public land for NBS development. Local NBS initiatives receive some support regarding funding, expertise and guidance, but not on a structural basis. The use of citizen science or the crowdsourcing of socio-ecological data is still relatively uncommon.

To a great extent (score=5): Citizens are actively contributing to the planning, design and implementation of NBS in the city, including their monitoring and maintenance. There are also examples of community lease or ownership of land to develop urban NBS. Public institution(s), together with experts, actively support local NBS initiatives with funding, expertise and guidance, whilst also facilitating social learning across initiatives. Citizen science is used for the crowdsourcing of socio-ecological data and actively supported with smart technologies.

Monitoring and assessment (question 6 A):

Not at all (score=1): There is no monitoring and assessment of relevant environmental, sociodemographic and socioeconomic conditions to inform decisions about which NBS to implement where in the city. Public institutions and other relevant decision-makers do not actively support, or engage in, the monitoring the impacts of urban NBS on various urban challenges, including environmental justice. Because of a lack of data, there is no central data repository supporting decision-making on NBS.

Moderately (score=3): There is a desire for more data-informed decisions about which NBS to implement where, but there are gaps in the available data on relevant environmental, sociodemographic and socioeconomic conditions in the city. Public institutions and other relevant decision-makers to some extent support, or engage in, the monitoring the impacts of urban NBS on various urban challenges, including environmental justice. The pooling of available data across locations and institutions could be improved, but some progress has been made in creating a central data repository supporting decision-making on NBS.

To a great extent (score=5): Decision-making about which NBS to implement where are informed by relevant data on environmental, sociodemographic and socioeconomic conditions in the city. Public institutions and other relevant decision-makers support and engage in monitoring the impacts of NBS on various urban challenges, including environmental justice. Available data is pooled across locations and institutions to create a central repository supporting decision-making on NBS.

Knowledge development and sharing (question 7 A):

Not at all (score=1): There is no or limited access to the level of expertise required for the development of various types of urban NBS in the city. There are few opportunities to acquire or share new knowledge relevant to NBS and no attempts are made to engage in social learning by inclusive dialogue and deliberation. There are no or very few environmental education activities aimed at the general public in the city.

Moderately (score=3): There is access to the relevant knowledge supporting the development of some types of urban NBS in the city, but not others. Decision-makers occasionally make use of training opportunities and knowledge platforms to develop and share their expertise. Urban NBS planning and design approaches evolve over time, but this is not necessarily informed by inclusive dialogue and deliberation or NBS monitoring. Some environmental education activities have been organized in the city to improve environmental awareness and public support for NBS, but these remain few and far between.

To a great extent (score=5): There is a broad knowledge base supporting the development of various types of urban NBS in the city. Decision-makers regularly make use of training opportunities and knowledge platforms to develop and share their expertise. Urban NBS planning and design approaches evolve over time, informed by inclusive dialogue and deliberation as well as emerging insights from NBS monitoring. Environmental education activities are regularly organized in the city to improve environmental awareness and public support for NBS.

Financing mechanisms (question 8 A):

Not at all (score=1): Finance for urban NBS is inadequate, resulting in poor maintenance and the loss of natural assets. Public institutions and other relevant decision-makers do not actively explore alternative revenue streams for NBS provided by international cooperation agencies, NGOs, public-private partnerships, charging for nature products and services or other options.

Moderately (score=3): Some financing mechanisms for urban NBS are used, but there is scope for using a broader diversity of instruments. Public institutions and other relevant decision-makers tentatively explore alternative revenue streams for NBS provided by international cooperation agencies, NGOs, public-private partnerships, charging for nature products and services or other options.

To a great extent (score=5): A variety of financing mechanisms for urban NBS are used, varying from direct funding to subsidies and impact fees charged to urban developers. Public institutions and other relevant decision-makers actively explore, or make use of, alternative revenue streams for NBS provided by international cooperation agencies, NGOs, public-private partnerships, charging for nature products and services or other options.

Valuing diversity, equity and inclusion (question 9 A):

Not at all (score=1): There is no recognition of diversity of interests, knowledges, values, etc. by diverse groups (age, gender, income, ethnicity), resulting in homogenous NBS design, planning and management approaches in the city. Different social groups are uninvolved in decision-making processes relevant to NBS development. There have been no attempts to understand how NBS are distributed across the city and how these might contribute to gentrification. Consequently, there is inequitable access to safe and high-quality urban nature and providing protection against climate-related risk (e.g., urban heat islands).

Moderately (score=3): There is an emerging understanding of the need to consider interests, knowledges, values, etc. by diverse groups (age, gender, income, ethnicity) in NBS design, planning and management in the city. Whilst some social groups are represented in decision-making processes relevant to NBS development, others are not. There is an incomplete understanding of how NBS are distributed across the city and how these might contribute to gentrification. Consequently, no concerted effort is made to redress inequitable access to safe and high-quality urban nature providing protection against climate-related risk (e.g., urban heat islands).

To a great extent (score=5): A plurality of interests, knowledges, values, etc. by diverse groups (age, gender, income, ethnicity) are recognized as being important to NBS design, planning and management in the city. Various social groups are provided with equal opportunities to contribute to decision-making relevant to urban nature. Efforts are made to distribute NBS more equitably across the city. Consequently, an increasing number of communities have good access to safe and high-quality urban nature protecting them against climate-related risk (e.g., urban heat islands), whilst environmental gentrification is mostly avoided.

Appendix C. Associated indicators from the European Commission's Handbook for Evaluating the Impact of Nature-Based Solutions

Governance indicator	Associated Handbook indicator (s)	Indicator code
Agency		
Governance structure	1. Strategic alignment	18.18
Legislation, regulations & policies	1. Development of a climate resilience strategy	18.8
	2. Alignment of climate resilience strategy with UNISDR defined elements	18.9
Collaborative arrangements	1. Openness of participatory processes	17.1
	2. Public-private partnerships activated	17.3
	3. Stakeholder involvement in co-creation/co-design of NBS	18.1.2
	4. Activation of public-private collaboration	18.14
	5. Linking social capital	20.1
Active community engagement	1. Openness of participatory processes: proportion of citizens involved	17.1.1
	2. Sense of empowerment: perceived control and influence over decision-making	17.2
	3. Trust in decision-making procedures and decision makers	17.5
	4. Community involvement in planning	18.1
	5. Community involvement in implementation	18.2
	6. Active engagement of citizens in decision-making	18.4
	7. Number of governance innovations adopted	18.6
	8. Proportion of community who volunteer	20.7
Monitoring and assessment		
Knowledge development and sharing	1. Green intelligence awareness	16.6
	2. Policy learning for mainstreaming NBS	17.4
	3. Consciousness of citizenship	18.5
	4. Facilitation skills for co-production	18.16
	5. Adaptation of local plans and regulations to include NBS	18.10
	6. Perceived ease of governance of NBS	18.11
	7. Reflexivity: identified learning outcomes	18.15
	8. Reflexivity: time for reflection	18.19
Financing mechanisms	1. Adoption of new forms of NBS (co-)financing	18.7
Valuing diversity, equity and inclusion	1. Green space accessibility	7.1
	2. Betweenness centrality	8.34
	3. Diversity of stakeholders involved	18.12
	4. Transparency of co-production	18.13
	5. Procedural fairness	18.17
	6. Inclusion of different social groups in NBS projects	19.2
	7. Availability and equitable distribution of blue-green space	19.6
	8. Proportion of target group reached by an NBS project	20.8
	9. Area easily accessible for people with disabilities	20.13
	10. Change in properties incomes	20.14

References

Ahmed, S., Meenar, M., Alam, A., 2019. Designing a blue-green infrastructure (BGI) network: toward water-sensitive urban growth planning in Dhaka, Bangladesh. Land 8, 138.

Almassy, D., Pinter, L., Rocha, S., Naumann, S., Davis, M., Abhold, K., Bulkeley, H., 2018. Urban Nature Atlas: A Database of Nature-Based Solutions Across 100 European Cities. NATURVATION.

Ambrose-Oji, B., Buijs, A., Gerőházi, E., Mattijssen, T., Száraz, L., van der Jagt, A.P.N., Hansen, R., Rall, E., Andersson, E., Kronenberg, J., Rolf, W., 2017. Innovative governance for urban green infrastructure: a guide for practitioners. GREEN SURGE Deliv. 6, 3.

Andersson, E., 2018. Functional landscapes in cities: a systems approach. Landsc. Ecol. Eng. 14, 193–199. https://doi.org/10.1007/s11355-017-0346-6.

Andersson, E., Barthel, S., Borgström, S., Colding, J., Elmqvist, T., Folke, C., Gren, Å., 2014. Reconnecting cities to the biosphere: stewardship of green infrastructure and urban ecosystem services. Ambio 43 (4), 445–453. https://doi.org/10.1007/s13280-014-0506-y.

Andersson, K., Angelstam, P., Elbakidze, M., Axelsson, R., Degerman, E., 2013. Green infrastructures and intensive forestry: Need and opportunity for spatial planning in a Swedish rural–urban gradient. Scand. J. For. Res. 28 (2), 143–165. https://doi.org/10.1080/02827581.2012.723740.

Arts, B., 2021. Forest Governance: Hydra or Chloris? Cambridge University Press. https://doi.org/10.1017/9781108863551.

Assmuth, T., Hellgren, D., Kopperoinen, L., Paloniemi, R., Peltonen, L., 2017. Fair blue urbanism: Demands, obstacles, opportunities and knowledge needs for just recreation beside Helsinki Metropolitan Area waters. Int. J. Urban Sustain. Dev. 9 (3), 253–273. https://doi.org/10.1080/19463138.2017.1370423.

Aubrechtová, T., Semančíková, E., Raška, P., 2020. Formulation matters! The failure of integrating landscape fragmentation policy. Sustainability 12, 3962. https://doi.org/10.3390/SU12103962.

Bayulken, B., Huisingh, D., Fisher, P.M.J., 2021. How are nature based solutions helping in the greening of cities in the context of crises such as climate change and pandemics? A comprehensive review. J. Clean. Prod. 288, 125569 https://doi.org/10.1016/j.jclepro.2020.125569.

BenDor, T.K., Shandas, V., Miles, B., Belt, K., Olander, L., 2018. Ecosystem services and U.S. stormwater planning: an approach for improving urban stormwater decisions. Environ. Sci. Policy 88, 92–103. https://doi.org/10.1016/j.envsci.2018.06.006.

Benton-Short, L., Keeley, M., Rowland, J., 2019. Green infrastructure, green space, and sustainable urbanism: geography's important role. Urban Geogr. 40 (3), 330–351. https://doi.org/10.1080/02723638.2017.1360105.

Botzat, A., Fischer, L.K., Kowarik, I., 2016. Unexploited opportunities in understanding liveable and biodiverse cities. A review on urban biodiversity perception and valuation. Glob. Environ. Change 39, 220–233. https://doi.org/10.1016/j.gloenvcha.2016.04.008.

Buijs, A., Hansen, R., van der Jagt, A.P.N., Ambrose-Oji, B., Elands, B., Lorance Rall, E., Mattijssen, T., Pauleit, S., Runhaar, H., Stahl Olafsson, A., Steen Møller, M., 2019. Mosaic governance for urban green infrastructure: upscaling active citizenship from a local government perspective. Urban For. Urban Green. 40, 53–62. https://doi.org/10.1016/j.ufug.2018.06.011.

Buijs, A., Mattijssen, T., Arts, B., 2014. "The man, the administration and the counter-discourse": an analysis of the sudden turn in Dutch nature conservation policy. Land Use Policy 38, 676–684. https://doi.org/10.1016/j.landusepol.2014.01.010.

Buijs, A., Mattijssen, T.J., van der Jagt, A.P.N., Ambrose-Oji, B., Andersson, E., Elands, B. H., Steen Møller, M., 2016. Active citizenship for urban green infrastructure: fostering the diversity and dynamics of citizen contributions through mosaic governance. Curr. Opin. Environ. Sustain. 22, 1–6. https://doi.org/10.1016/j.cosust.2017.01.002.

Bulkeley, H., 2021. Climate changed urban futures: environmental politics in the anthropocene city. Environ. Polit. 30 (1–2), 266–284. https://doi.org/10.1080/09644016.2021.1880713.

Bulkeley, H., Coenen, L., Frantzeskaki, N., Hartmann, C., Kronsell, A., Mai, L., Marvin, S., McCormick, K., van Steenbergen, F., Voytenko Palgan, Y., 2016. Urban living labs: governing urban sustainability transitions. Curr. Opin. Environ. Sustain. 22, 13–17. https://doi.org/10.1016/j.cosust.2017.02.003.

Campbell, L.K., Svendsen, E.S., Roman, L.A., 2016. Knowledge co-production at the research–practice interface: embedded case studies from urban forestry. Environ. Manag. 57, 1262–1280. https://doi.org/10.1007/s00267-016-0680-8.

Campbell-Arvai, V., Lindquist, M., 2021. From the ground up: Using structured community engagement to identify objectives for urban green infrastructure planning. Urban For. Urban Green. 59, 127013 https://doi.org/10.1016/j.ufug.2021.127013.

Clark, C., Ordóñez, C., Livesley, S.J., 2020. Private tree removal, public loss: valuing and enforcing existing tree protection mechanisms is the key to retaining urban trees on private land. Landsc. Urban Plan. 203, 103899 https://doi.org/10.1016/j.landurbplan.2020.103899.

Coenen, F.H.J.M., 2009. Public participation and better environmental decisions: The promise and limits of participatory processes for the quality of environmentally related decision-making. Springer,, Dordrecht.

Cousins, J.J., 2021. Justice in nature-based solutions: research and pathways. Ecol. Econ. 180, 106874 https://doi.org/10.1016/j.ecolecon.2020.106874.

Croeser, T., Garrard, G.E., Thomas, F.M., Tran, T.D., Mell, I., Clement, S., Bekessy, S., 2021. Diagnosing delivery capabilities on a large international nature-based solutions project. npj Urban Sustain. 1, 32. https://doi.org/10.1038/s42949-021-00036-8.

Dawson, N.M., Coolsaet, B., Sterling, E.J., Loveridge, R., Gross-Camp, N.D., Wongbusarakum, S., Sangha, K.K., Scherl, L.M., Phan, H.P., Zafra-Calvo, N., Lavey, W.G., Byakagaba, P., Idrobo, C.J., Chenet, A., Bennett, N.J., Mansourian, S., Rosado-May, F.J., 2021. The role of Indigenous peoples and local communities in effective and equitable conservation. Ecol. Soc. 26 (3), art19. https://doi.org/10.5751/ES-12625-260319.

de Oliveira Fontes, L., 2020. From cultural formation to social mobilization: spaces for formation and mobilization over three generations in the São Paulo outskirts. Lua Nova: Rev. De. Cult. e Política 109, 51–101. https://doi.org/10.1590/0102-051101/109.

de Vries, S., Buijs, A.E., Snep, R.P.H., 2020. Environmental justice in the Netherlands: presence and quality of greenspace differ by socioeconomic status of neighbourhoods. Sustainability 12 (15), 5889. https://doi.org/10.3390/su12155889.

Dearden, P., Emphandhu, D., Songpornwanich, S., Ruksapol, A., 2017. Koh Pitak: A community-based, environment and tourism initiative in Thailand Dearden, P., D. Emphandhu, S. Songpornwanich, and A. Ruksapol. In: Armitage, D., Charles, A., Berkes, F. (Eds.), Governing the coastal commons: Communities, resilience and transformation. Routledge, London.

Dobbs, C., Escobedo, F.J., Clerici, N., de la Barrera, F., Eleuterio, A.A., MacGregor-Fors, I., Reyes-Paecke, S., Vásquez, A., Camaño, J.D.Z., Hernández, H.J., 2019. Urban ecosystem Services in Latin America: mismatch between global concepts and regional realities? Urban Ecosyst. 22, 173–187.

Donaldson, G.H., João, E.M., 2020. Using green infrastructure to add value and assist place-making in public realm developments. Impact Assess. Proj. Apprais. 38 (6), 464–478. https://doi.org/10.1080/14615517.2019.1648731.

Dorst, H., van der Jagt, A.P.N., Raven, R., Runhaar, H., 2019. Urban greening through nature-based solutions – key characteristics of an emerging concept. Sustain. Cities Soc., 101620 https://doi.org/10.1016/j.scs.2019.101620.

Dorst, H., van der Jagt, A.P.N., Toxopeus, H., Tozer, L., Raven, R., Runhaar, H., 2022. What's behind the barriers? uncovering structural conditions working against urban nature-based solutions. Landsc. Urban Plan. 220, 104335 https://doi.org/10.1016/j.landurbplan.2021.104335.

Draus, P., Lovall, S., Formby, T., Baldwin, L., Lowe-Anderson, W., 2019. A green space vision in Southeast Michigan's most heavily industrialized area. Urban Ecosyst. 22 (1), 91–102. https://doi.org/10.1007/s11252-018-0765-7.

Driessen, P.P.J., Dieperink, C., van Laerhoven, F., Runhaar, H.A.C., Vermeulen, W.J.V., 2012. Towards a conceptual framework for the study of shifts in modes of environmental governance—experiences from The Netherlands. Environ. Policy Gov. 22 (3), 143–160. https://doi.org/10.1002/eet.1580.

Duinker, P.N., Ordóñez, C., Steenberg, J.W.N., Miller, K.H., Toni, S.A., Nitoslawski, S.A., 2015. Trees in Canadian cities: indispensable life form for urban sustainability. *Sustainability (Switzerland)*, 7 (6), 7379–7396. https://doi.org/10.3390/su7067379.

Dumitru, A., Wendling, L., 2021. Evaluating the Impact of Nature-Based Solutions: A Handbook for Practitioners. European Commission, Directorate-General for Research and Innovation,.

Dushkova, D., Haase, D., 2020. Not Simply Green: Nature-Based Solutions as a Concept and Practical Approach for Sustainability Studies and Planning Agendas in Cities. Land 9, 19.

Dyca, B., Muldoon-Smith, K., Greenhalgh, P., 2020. Common value: Transferring development rights to make room for water. Environ. Sci. Policy 114, 312–320. https://doi.org/10.1016/j.envsci.2020.08.017.

Egusquiza, A., Cortese, M., Perfido, D., 2019. Mapping of innovative governance models to overcome barriers for nature based urban regeneration. IOP Conf. Ser.: Earth Environ. Sci. 323 (1) https://doi.org/10.1088/1755-1315/323/1/012081.

Elands, B.H.M., Vierikko, K., Andersson, E., Fischer, L.K., Gonçalves, P., Haase, D., Kowarik, I., Luz, A.C., Niemelä, J., Santos-Reis, M., Wiersum, K.F., 2019. Biocultural diversity: A novel concept to assess human-nature interrelations, nature conservation and stewardship in cities. Urban For. Urban Green. 40, 29–34. https://doi.org/10.1016/j.ufug.2018.04.006.

European Commission, 2022. Proposal for a Regulation of the European Parliament and of the Council on nature restoration. DG Environment, European Commission,. ⟨https://environment.ec.europa.eu/publications/nature-restoration-law_en⟩.

Fan, P., Ouyang, Z., Basnou, C., Pino, J., Park, H., Chen, J., 2017. Nature-based solutions for urban landscapes under post-industrialization and globalization: Barcelona versus Shanghai. Environ. Res. 156, 272–283. https://doi.org/10.1016/j.envres.2017.03.043.

Ferguson, M., Roberts, H.E., McEachan, R.R.C., Dallimer, M., 2018. Contrasting distributions of urban green infrastructure across social and ethno-racial groups. Landsc. Urban Plan. 175, 136–148. https://doi.org/10.1016/j.landurbplan.2018.03.020.

Ferreira, V., Barreira, A.P., Antunes, D., Panagopoulos, T., 2020. Stakeholders' engagement on nature-based solutions: a systematic literature review. Sustainability 12, 640.

Finewood, M.H., Matsler, A.M., Zivkovich, J., 2019. Green infrastructure and the hidden politics of urban stormwater governance in a postindustrial city. Ann. Am. Assoc. Geogr. 109 (3), 909–925. https://doi.org/10.1080/24694452.2018.1507813.

Fink, J.H., 2019. Contrasting governance learning processes of climate-leading and -lagging cities: portland, oregon, and phoenix, Arizona, USA. J. Environ. Policy Plan. 21 (1), 16–29. https://doi.org/10.1080/1523908X.2018.1487280.

Folke, C., 2004. Traditional Knowledge in Social-Ecological Systems. Ecol. Soc. 9 (3), 7. https://doi.org/10.5751/ES-01237-090307.

Fors, H., Hagemann, F.A., Sang, Å.O., Randrup, T.B., 2021. Striving for inclusion—a systematic review of long-term participation in strategic management of urban green spaces. Front. Sustain. Cities 3, 572423. https://doi.org/10.3389/frsc.2021.572423.

Frantzeskaki, N., 2019. Seven lessons for planning nature-based solutions in cities. Environ. Sci. Policy 93, 101–111. https://doi.org/10.1016/j.envsci.2018.12.033.

Frantzeskaki, N., Dumitru, A., Anguelovski, I., Avelino, F., Bach, M., Best, B., Binder, C., Barnes, J., Carrus, G., Egermann, M., Haxeltine, A., Moore, M.-L., Mira, R.G., Loorbach, D., Uzzell, D., Omann, I., Olsson, P., Silvestri, G., Stedman, R., Rauschmayer, F., 2016. Elucidating the changing roles of civil society in urban sustainability transitions. Curr. Opin. Environ. Sustain. 22, 41–50. https://doi.org/10.1016/j.cosust.2017.04.008.

Frantzeskaki, N., Mcphearson, T., Collier, M.J., Kendal, D., Bulkeley, H., Dumitru, A., Walsh, C., Noble, K., Wyk, E.V.A.N., Ordóñez, C., Oke, C., 2019. Nature-based solutions for urban climate change adaptation: linking science, policy, and practice communities for evidence-based decision-making. BioScience 69 (6), 455–466. https://doi.org/10.1093/biosci/biz034.

Frantzeskaki, N., McPhearson, T., Kabisch, N., 2021. Urban sustainability science: prospects for innovations through a system's perspective, relational and transformations' approaches: This article belongs to Ambio's 50th Anniversary Collection. Theme: Urbanization. Ambio 50 (9), 1650–1658. https://doi.org/10.1007/s13280-021-01521-1.

Frantzeskaki, N., Tilie, N., 2014. The dynamics of urban ecosystem governance in rotterdam. Netherlands 542–555. https://doi.org/10.1007/s13280-014-0512-0.

Fuenfschilling, L., 2019. An institutional perspective on sustainability transitions. In: Boons, F., McMeekin, A. (Eds.), Handbook of Sustainable Innovation. Edward Elgar Publishing, pp. 219–236. https://doi.org/10.4324/9780203465271.

Gabriel, N., 2016. "No place for wilderness": Urban parks and the assembling of neoliberal urban environmental governance. Urban For. Urban Green. 19, 278–284. https://doi.org/10.1016/j.ufug.2016.02.006.

Glaser, B.G., 1965. The constant comparative method of qualitative analysis. Soc. Probl. 12 (4), 436–445. https://doi.org/10.2307/798843.

Gould, K.A., Lewis, T.L., 2017. Green Gentrification: Urban Sustainability and the Struggle for Environmental Justice. Routledge,.

Gulsrud, N.M., Hertzog, K., Shears, I., 2018. Innovative urban forestry governance in Melbourne? Investigating "green placemaking" as a nature-based solution. Environ. Res. 161, 158–167. https://doi.org/10.1016/j.envres.2017.11.005.

Gulsrud, N.M., Raymond, C.M., Rutt, R.L., Olafsson, A.S., Plieninger, T., Sandberg, M., Beery, T.H., Jönsson, K.I., 2018. 'Rage against the machine'? The opportunities and risks concerning the automation of urban green infrastructure. Landsc. Urban Plan. 180, 85–92. https://doi.org/10.1016/j.landurbplan.2018.08.012.

Haase, D., Kabisch, S., Haase, A., Andersson, E., Banzhaf, E., Baró, F., Brenck, M., Fischer, L.K., Frantzeskaki, N., Kabisch, N., Krellenberg, K., Kremer, P., Kronenberg, J., Larondelle, N., Mathey, J., Pauleit, S., Ring, I., Rink, D., Schwarz, N., Wolff, M., 2017. Greening cities – To be socially inclusive? About the alleged paradox of society and ecology in cities. Habitat Int. 64, 41–48. https://doi.org/10.1016/j.habitatint.2017.04.005.

Hajer, M., Nilsson, M., Raworth, K., Bakker, P., Berkhout, F., de Boer, Y., Rockström, J., Ludwig, K., Kok, M., 2015. Beyond cockpit-ism: four insights to enhance the transformative potential of the sustainable development goals. Sustainability 7, 1651–1660. https://doi.org/10.3390/su7021651.

Hansen, R., Olafsson, A.S., van der Jagt, A.P.N., Rall, E., Pauleit, S., 2019. Planning multifunctional green infrastructure for compact cities: What is the state of practice? Ecol. Indic. 96, 99–110.

Hansen, R., Rall, E., Chapman, E., Rolf, W., Pauleit, S., 2017. Urban green infrastructure planning: a guide for practitioners. GREEN SURGE Deliv. 5, 3.

Hazrati, M., Heffron, R.J., 2021. Conceptualising restorative justice in the energy transition: changing the perspectives of fossil fuels. Energy Res. Soc. Sci. 78, 102115 https://doi.org/10.1016/j.erss.2021.102115.

Héritier, A., 2002. New modes of governance in europe: policy-making without legislating. SSRN Electron. J. https://doi.org/10.2139/ssrn.299431.

Herslund, L., Mguni, P., 2019. Examining urban water management practices – challenges and possibilities for transitions to sustainable urban water management in Sub-Saharan cities. Sustain. Cities Soc. 48, 101573 https://doi.org/10.1016/j.scs.2019.101573.

Hobbie, S.E., Grimm, N.B., 2020. Nature-based approaches to managing climate change impacts in cities. Philos. Trans. R. Soc. B: Biol. Sci. 375 (1794), 20190124. https://doi.org/10.1098/rstb.2019.0124.

Ibrahim, A., Bartsch, K., Shari, E., 2020. Green infrastructure needs green governance: Lessons from Australia's largest integrated stormwater management project, the River Torrens Linear Park. J. Clean. Prod. 261, 121202 https://doi.org/10.1016/j.jclepro.2020.121202.

IUCN, 2020. IUCN Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of NbS (First edit). IUCN,, Gland, Switzerland.

Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., Knapp, S., Korn, H., Stadler, J., Zaunberger, K., Bonn, A., 2016. Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. Ecol. Soc. 21 (2), 39.

Kirsop-Taylor, N., Russel, D., Jensen, A., 2021. Urban governance and policy mixes for nature-based solutions and integrated water policy. J. Environ. Policy Plan., Ahead–Print. 1–15. https://doi.org/10.1080/1523908X.2021.1956309.

Kloek, M.E., Buijs, A.E., Boersema, J.J., Schouten, M.G.C., 2013. Crossing borders: review of concepts and approaches in research on greenspace, immigration and society in northwest european countries. Landsc. Res. 38 (1), 117–140. https://doi.org/10.1080/01426397.2012.690861.

Kooiman, J., 2003. Governing as Governance. Sage Publications Inc.

Kordana, S., Daniel, S., 2020. An analysis of important issues impacting the development of stormwater management systems in Poland. Sci. Total Environ. 727, 138711 https://doi.org/10.1016/j.scitotenv.2020.138711.

Kowarik, I., 2019. The "Green Belt Berlin": Establishing a greenway where the Berlin Wall once stood by integrating ecological, social and cultural approaches. Landsc. Urban Plan. 184, 12–22. https://doi.org/10.1016/j.landurbplan.2018.12.008.

Kuller, M., Bach, P.M., Roberts, S., Browne, D., Deletic, A., 2019. A planning-support tool for spatial suitability assessment of green urban stormwater infrastructure. Sci. Total Environ. 686, 856–868. https://doi.org/10.1016/j.scitotenv.2019.06.051.

Kvamsås, H., 2021. Addressing the adaptive challenges of alternative stormwater planning. J. Environ. Policy Plan. 1–13. https://doi.org/10.1080/1523908X.2021.1921568.

Lange, P., Driessen, P.P.J., Sauer, A., Bornemann, B., Burger, P., 2013. Governing towards sustainability-conceptualizing modes of governance. J. Environ. Policy Plan. 15 (3), 403–425. https://doi.org/10.1080/1523908X.2013.769414.

Langemeyer, J., Camps-Calvet, M., Calvet-Mir, L., Barthel, S., Gómez-Baggethun, E., 2018. Stewardship of urban ecosystem services: Understanding the value(s) of urban gardens in Barcelona. Landsc. Urban Plan. 170, 79–89. https://doi.org/10.1016/j.landurbplan.2017.09.013.

Langemeyer, J., Connolly, J.J.T., 2020. Weaving notions of justice into urban ecosystem services research and practice. Environ. Sci. Policy 109, 1–14. https://doi.org/10.1016/j.envsci.2020.03.021.

Larson, K.L., Wiek, A., Withycombe, L., 2013. A comprehensive sustainability appraisal of water governance in Phoenix, AZ. J. Environ. Manag. 116, 58–71. https://doi.org/10.1016/j.jenvman.2012.11.016.

Larsson, J., Williams, S., Holmberg, J., 2018. Guid. Syst. Chang.: A Cross-case Anal. ' Transit. Labs ' Can. Swed. 1–29.

Lawrence, A., De Vreese, R., Johnston, M., Konijnendijk van den Bosch, C.C., Sanesi, G., 2013. Urban forest governance: towards a framework for comparing approaches. Urban For. Urban Green. 12 (4), 464–473. https://doi.org/10.1016/j.ufug.2013.05.002.

Lawrence, T.B., 1999. Institutional Strategy. J. Manag. 25 (2), 161–188.

Li, L., Collins, A.M., Cheshmehzangi, A., Chan, F.K.S., 2020. Identifying enablers and barriers to the implementation of the Green Infrastructure for urban flood management: a comparative analysis of the UK and China. Urban For. Urban Green. 54, 126770 https://doi.org/10.1016/j.ufug.2020.126770.

Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gotzsche, P.C., Ioannidis, J.P.A., Clarke, M., Devereaux, P.J., Kleijnen, J., Moher, D., 2009. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. BMJ 339 (jul21 1), b2700. https://doi.org/10.1136/bmj.b2700.

Lin, B.B., Meyers, J.A., Barnett, G.B., 2019. Establishing priorities for urban green infrastructure research in Australia. Urban Policy Res. 37 (1), 30–44. https://doi.org/10.1080/08111146.2018.1523054.

Martin, J.G.C., Scolobig, A., Linnerooth-Bayer, J., Liu, W., Balsiger, J., 2021. Catalyzing innovation: governance enablers of nature-based solutions. Sustainability 13 (4), 1971. https://doi.org/10.3390/su13041971.

Mattijssen, T., Buijs, A., Elands, B., 2018. The benefits of self-governance for nature conservation: a study on active citizenship in the Netherlands. J. Nat. Conserv. 43, 19–26. https://doi.org/10.1016/j.jnc.2018.01.006.

McPhearson, T., M. Raymond, C., Gulsrud, N., Albert, C., Coles, N., Fagerholm, N., Nagatsu, M., Olafsson, A.S., Soininen, N., Vierikko, K., 2021. Radical changes are needed for transformations to a good Anthropocene. Npj Urban Sustain. 1 (1), 5. https://doi.org/10.1038/s42949-021-00017-x.

Meerow, S., Newell, J.P., 2019. Urban resilience for whom, what, when, where, and why. Urban Geogr. 40 (3), 309–329. https://doi.org/10.1080/02723638.2016.1206395.

Mell, I., 2020a. The impact of austerity on funding green infrastructure: a DPSIR evaluation of the Liverpool Green & Open Space Review (LG&OSR), UK. Land Use Policy *91*. https://doi.org/10.1016/j.landusepol.2019.104284.

Mell, I., 2020b. What future for green infrastructure planning? evaluating the changing environment for green infrastructure planning following the revocation of regional planning policy in England. Plan. Pract. Res. 35 (1), 18–50. https://doi.org/10.1080/02697459.2020.1714271.

Mguni, P., Herslund, L., Bergen, M., 2016. Sustainable urban drainage systems: examining the potential for green infrastructure-based stormwater management for Sub-Saharan cities. Nat. Hazards 82 (2), 241–257. https://doi.org/10.1007/s11069-016-2309-x.

Mguni, P., Herslund, L., Jensen, M.B., 2015. Green infrastructure for flood-risk management in dar es salaam and copenhagen: exploring the potential for transitions towards sustainable urban water management. Water Policy 17 (1), 126–142. https://doi.org/10.2166/wp.2014.047.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., 2009. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA Statement. J. Clin. Epidemiol. 62 (10), 1006–1012. https://doi.org/10.1016/j.jclinepi.2009.06.005.

Nagendra, H., Bai, X., Brondizio, E.S., Lwasa, S., 2018. The urban south and the predicament of global sustainability. Nat. Sustain. 1 (7), 341–349. https://doi.org/10.1038/s41893-018-0101-5.

Nastran, M., Regina, H., 2016. Advancing urban ecosystem governance in Ljubljana. Environ. Sci. Policy 62, 123–126. https://doi.org/10.1016/j.envsci.2015.06.003.

Nederhand, J., Klijn, E.-H., van der Steen, M., van Twist, M., 2019. The governance of self-organization: which governance strategy do policy officials and citizens prefer. Policy Sci. 52 (2), 233–253. https://doi.org/10.1007/s11077-018-9342-4.

Nesbitt, L., Meitner, M.J., Sheppard, S.R.J., Girling, C., 2018. The dimensions of urban green equity: a framework for analysis. Urban For. Urban Green. 34, 240–248. https://doi.org/10.1016/j.ufug.2018.07.009.

Nielsen, A.B., Hedblom, M., Olafsson, A.S., Wiström, B., 2017. Spatial configurations of urban forest in different landscape and socio-political contexts: Identifying patterns for green infrastructure planning. Urban Ecosyst. 20 (2), 379–392. https://doi.org/10.1007/s11252-016-0600-y.

O'Donnell, E.C., Lamond, J.E., Thorne, C.R., 2018. Learning and action alliance framework to facilitate stakeholder collaboration and social learning in urban flood risk management. Environ. Sci. Policy 80, 1–8. https://doi.org/10.1016/j.envsci.2017.10.013.

O'Donnell, E., Netusil, N., Chan, F., Dolman, N., Gosling, S., 2021. International perceptions of urban blue-green infrastructure: a Comparison across four cities. Water 13 (4), 544. https://doi.org/10.3390/w13040544.

Ordóñez, C., Threlfall, C.G., Kendal, D., Hochuli, D.F., Davern, M., Fuller, R.A., van der Ree, R., Livesley, S.J., 2019. Urban forest governance and decision-making: a systematic review and synthesis of the perspectives of municipal managers. Landsc. Urban Plan. 189, 166–180. https://doi.org/10.1016/j.landurbplan.2019.04.020.

Pasimeni, M.R., Valente, D., Zurlini, G., Petrosillo, I., 2019. The interplay between urban mitigation and adaptation strategies to face climate change in two European countries. Environ. Sci. Policy 95, 20–27. https://doi.org/10.1016/j.envsci.2019.02.002.

Pauleit, S., Ambrose-Oji, B., Andersson, E., Anton, B., Buijs, A., Haase, D., Elands, B., Hansen, R., Kowarik, I., Kronenberg, J., Mattijssen, T., Stahl Olafsson, A., Rall, E., van der Jagt, A.P.N., Konijnendijk van den Bosch, C., 2019. Advancing urban green infrastructure in Europe: outcomes and reflections from the GREEN SURGE project. Urban For. Urban Green. 40, 4–16. https://doi.org/10.1016/j.ufug.2018.10.006.

Pauleit, S., Zölch, T., Hansen, R., Randrup, T.B., Konijnendijk van den Bosch, C.C., 2017. Nature-based solutions and climate change – four shades of green. In: Kabisch, N., Korn, H., Stadler, J., Bonn, A. (Eds.), Nature-Based Solutions to Climate Change Adaptation in Urban Areas. Springer, pp. 29–49.

Pineda-Pinto, M., Frantzeskaki, N., Nygaard, C.A., 2022. The potential of nature-based solutions to deliver ecologically just cities: Lessons for research and urban planning from a systematic literature review. Ambio 51, 167–182. https://doi.org/10.1007/s13280-021-01553-7.

Puskás, N., Abunnasr, Y., Naalbandian, S., 2021. Assessing deeper levels of participation in nature-based solutions in urban landscapes – A literature review of real-world cases. Landsc. Urban Plan. 210, 104065 https://doi.org/10.1016/j.landurbplan.2021.104065.

Randrup, T.B., Buijs, A., Konijnendijk, C.C., Wild, T., 2020. Moving beyond the nature-based solutions discourse: Introducing nature-based thinking. Urban Ecosyst. 23, 919–926. https://doi.org/10.1007/s11252-020-00964-w.

Raymond, C.M., Pam, B., Breil, M., Nita, M.R., Kabisch, N., de Bel, M., Enzi, V., Frantzeskaki, N., Geneletti, D., Cardinaletti, M., Lovinger, L., Basnou, C., Monteiro, A., Robrecht, H., Sgrigna, G., Munari, L., Calfapietra, C., 2017. An impact evaluation framework to support planning and evaluation of nature-based solutions projects—an eklipse expert working group report. Centre for Ecology & Hydrology,, Wallingford (UK).

Reed, M.S., Vella, S., Challies, E., de Vente, J., Frewer, L., Hohenwallner-Ries, D., Huber, T., Neumann, R.K., Oughton, E.A., Sidoli del Ceno, J., van Delden, H., 2018. A theory of participation: What makes stakeholder and public engagement in environmental management work? a theory of participation. Restor. Ecol. 26, S7–S17. https://doi.org/10.1111/rec.12541.

Rigolon, A., Gibson, S., 2021. The role of non-governmental organizations in achieving environmental justice for green and blue spaces. Landsc. Urban Plan. 205, 103970 https://doi.org/10.1016/j.landurbplan.2020.103970.

Rogers, B.C., Dunn, G., Hammer, K., Novalia, W., de Haan, F.J., Brown, L., Brown, R.R., Lloyd, S., Urich, C., Wong, T.H.F., Chesterfield, C., 2020. Water Sensitive Cities Index: A diagnostic tool to assess water sensitivity and guide management actions. Water Res. 186, 116411 https://doi.org/10.1016/j.watres.2020.116411.

Rutt, R.L., Gulsrud, N.M., 2016. Green justice in the city: A new agenda for urban green space research in Europe. Urban For. Urban Green. 19, 123–127. https://doi.org/10.1016/j.ufug.2016.07.004.

Sarabi, S.E., Han, Q., Romme, A.G.L., de Vries, B., Wendling, L., 2019. Key enablers of and barriers to the uptake and implementation of nature-based solutions in urban settings: A review. Resources 8, 121. https://doi.org/10.3390/resources8030121.

Sarabi, S., Han, Q., Romme, A.G.L., de Vries, B., Valkenburg, R., den Ouden, E., 2020. Uptake and implementation of Nature-Based Solutions: An analysis of barriers using Interpretive Structural Modeling. J. Environ. Manag. 270, 110749 https://doi.org/10.1016/j.jenvman.2020.110749.

Schäffler, A., Swilling, M., 2013. Valuing green infrastructure in an urban environment under pressure—The Johannesburg case. Ecol. Econ. 86, 246–257. https://doi.org/10.1016/j.ecolecon.2012.05.008.

Schifman, L.A., Herrmann, D.L., Shuster, W.D., Ossola, A., Garmestani, A., Hopton, M.E., 2017. Situating green infrastructure in context: a framework for adaptive socio-hydrology in cities. Water Resour. Res. 53 (10), 10139–10154. https://doi.org/10.1002/2017WR020926.

Shih, W.-Y., Mabon, L., Puppim de Oliveira, J.A., 2020. Assessing governance challenges of local biodiversity and ecosystem services: Barriers identified by the expert community. Land Use Policy 91, 104291. https://doi.org/10.1016/j.landusepol.2019.104291.

Shkaruba, A., Skryhan, H., Likhacheva, O., Katona, A., Maryskevych, O., Kireyeu, V., Sepp, K., Shpakivska, I., 2021. Development of sustainable urban drainage systems in Eastern Europe: An analytical overview of the constraints and enabling conditions. J. Environ. Plan. Manag. 1–24. https://doi.org/10.1080/09640568.2021.1874893.

Skelcher, C., 2000. Changing images of the State: overloaded, hollowed-out, congested. Public Policy Adm. 15 (3), 3–19. https://doi.org/10.1177/095207670001500302.

Steen Møller, M., Stahl Olafsson, A., Vierikko, K., Sehested, K., Elands, B., Buijs, A., Konijnendijk van den Bosch, C.C., 2019. Participation through place-based e-tools: A valuable resource for urban green infrastructure governance? Urban For. Urban Green. 40, 245–253. https://doi.org/10.1016/j.ufug.2018.09.003.

Suleiman, L., 2021. Blue green infrastructure, from niche to mainstream: challenges and opportunities for planning in Stockholm. Technol. Forecast. Soc. Change 166, 120528. https://doi.org/10.1016/j.techfore.2020.120528.

Swyngedouw, E., 2005. Governance innovation and the citizen: The Janus face of governance-beyond-the-state. Urban Stud. 42 (11), 1991–2006. https://doi.org/10.1080/00420980500279869.

Tengö, M., Enqvist, J., West, S., Svedin, U., Masterson, V.A., Haider, L.J., 2022. Stewardship in the Anthropocene. In: Carnell, R., Mounsey, C. (Eds.), Stewardship and the Future of the Planet, 1st ed..,. Routledge, pp. 234–251. https://doi.org/10.4324/9781003219064-17.

Tiwary, A., Vilhar, U., Zhiyanski, M., Stojanovski, V., Dinca, L., 2020. Management of nature-based goods and services provisioning from the urban common: A pan-European perspective. Urban Ecosyst. 23 (3), 645–657. https://doi.org/10.1007/s11252-020-00951-1.

Toxopeus, H., Kotsila, P., Conde, M., Katona, A., van der Jagt, A.P.N., Polzin, F., 2020. How 'just' is hybrid governance of urban nature-based solutions? Cities 105, 102839. https://doi.org/10.1016/j.cities.2020.102839.

Tozer, L., Bulkeley, H., van der Jagt, A.P.N., Toxopeus, H., Xie, L., Runhaar, H., 2022. Catalyzing sustainability pathways: Navigating urban nature based solutions in Europe. Glob. Environ. Change 74, 102521. https://doi.org/10.1016/j.gloenvcha.2022.102521.

Treib, O., Bähr, H., Falkner, G., 2007. Modes of governance: Towards a conceptual clarification. J. Eur. Public Policy 14 (1), 1–20. https://doi.org/10.1080/135017606061071406.

Trentanovi, G., Campagnaro, T., Kowarik, I., Munafò, M., Semenzato, P., Sitzia, T., 2021. Integrating spontaneous urban woodlands into the green infrastructure: Unexploited opportunities for urban regeneration. Land Use Policy 102, 105221. https://doi.org/10.1016/j.landusepol.2020.105221.

van der Jagt, A.P.N., Buijs, A., Dobbs, C., Lierop, M., van, Pauleit, S., Randrup, T.B., Wild, T., 2023. An action framework for the participatory assessment of nature-based solutions in cities. Ambio 52 (1), 54–67. https://doi.org/10.1007/s13280-022-01772-6.

van der Jagt, A.P.N., Kiss, B., Hirose, S., Takahashi, W., 2021. Nature-based solutions or debacles? the politics of reflexive governance for sustainable and just cities. Front. Sustain. Cities 2, 583833. https://doi.org/10.3389/frsc.2020.583833.

van der Jagt, A.P.N., Raven, R., Dorst, H., Runhaar, H., 2020. Nature-based innovation systems. Environ. Innov. Soc. Transit. 35, 202–216. https://doi.org/10.1016/j.eist.2019.09.005.

van der Jagt, A.P.N., Tozer, L., Toxopeus, H., Runhaar, H., 2023. Policy mixes for mainstreaming urban nature-based solutions: an analysis of six European countries and the European Union. Environ. Sci. Policy 139, 51–61. https://doi.org/10.1016/j.envsci.2022.10.011.

Vaňo, S., Stahl Olafsson, A., Mederly, P., 2021. Advancing urban green infrastructure through participatory integrated planning: a case from Slovakia. Urban For. Urban Green. 58, 126957 https://doi.org/10.1016/j.ufug.2020.126957.

Wamsler, C., 2015. Mainstreaming ecosystem-based adaptation: Transformation toward sustainability in urban governance and planning. Ecol. Soc. 20 (2) https://doi.org/10.5751/ES-07489-200230.

Wamsler, C., Luederitz, C., Brink, E., 2014. Local levers for change: mainstreaming ecosystem-based adaptation into municipal planning to foster sustainability transitions. Glob. Environ. Change 29, 189–201. https://doi.org/10.1016/j.gloenvcha.2014.09.008.

Wamsler, C., Niven, L., Beery, T.H., Bramryd, T., Jönsson, K.I., Osmani, A., Palo, T., Stålhammar, S., 2016. Operationalizing ecosystem-based adaptation: Harnessing ecosystem services to buffer communities against climate change. Ecol. Soc. 21, 1.

Wamsler, C., Wickenberg, B., Hanson, H., Alkan Olsson, J., Stålhammar, S., Björn, H., Falck, H., Gerell, D., Oskarsson, T., Simonsson, E., Torffvit, F., Zelmerlow, F., 2020. Environmental and climate policy integration: Targeted strategies for overcoming barriers to nature-based solutions and climate change adaptation. J. Clean. Prod. 247, 119154 https://doi.org/10.1016/j.jclepro.2019.119154.

Wang, Y., van Roon, M., Knight-Lenihan, S., 2021. Opportunities and challenges in water sensitive industrial development: An Auckland case study, New Zealand. Int. J. Sustain. Dev. World Ecol. 28 (2), 143–156. https://doi.org/10.1080/13504509.2020.1783717.

Wiechmann, T., 2008. Strategische Planung. In: Fürst, D., Scholles, F. (Eds.), Handbuch Theorien und Methoden der Raum- und Umweltplanung. Rohn, pp. 265–275.

Wild, T., Dempsey, N., Broadhead, A.T., 2019. Volunteered information on nature-based solutions—dredging for data on deculverting. Urban For. Urban Green. 40, 254–263. https://doi.org/10.1016/j.ufug.2018.08.019.

Wild, T., Freitas, T., Vandewoestijne, S., 2020. Nature-based solutions: state of the Art in EU-funded projects. European Commission, Brussels.

Wolfram, M., 2018. Cities shaping grassroots niches for sustainability transitions: conceptual reflections and an exploratory case study. J. Clean. Prod. 173 (August), 11–23. https://doi.org/10.1016/j.jclepro.2016.08.044.

Workalemahu Habtemariam, L., Byskov Herslund, L., Mguni, P., 2019. What makes a champion for landscape-based storm water management in Addis Ababa. Sustain. Cities Soc. 46, 101378 https://doi.org/10.1016/j.scs.2018.12.006.

Xie, L., Bulkeley, H., 2020. Nature-based solutions for urban biodiversity governance. Environ. Sci. Policy 110, 77–87. https://doi.org/10.1016/j.envsci.2020.04.002.

Xie, L., Bulkeley, H., Tozer, L., 2022. Mainstreaming sustainable innovation: unlocking the potential of nature-based solutions for climate change and biodiversity. Environ. Sci. Policy 132, 119–130. https://doi.org/10.1016/j.envsci.2022.02.017.

Zevenbergen, C., Fu, D., Pathirana, A., 2018. Transitioning to sponge cities: challenges and opportunities to address urban water problems. Water 10 (1230). https://doi.org/10.3390/w10091230.

Zuniga-Teran, A.A., Staddon, C., Vito, L.D., Gerlak, A.K., Ward, S., Schoeman, Y., Hart, A., Booth, G., Staddon, C., Vito, L.D., Gerlak, A.K., Ward, S., Schoeman, Y., Hart, A., Booth, G., 2020. Challenges of mainstreaming green infrastructure in built environment professions. J. Environ. Plan. Manag. 63 (4), 710–732. https://doi.org/10.1080/09640568.2019.1605890.