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# Whose knowledge counts in nature-based solutions? Understanding epistemic justice for nature-based solutions through a multi-city comparison across Europe and Asia

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ABSTRACT

There is increasing advocacy from academics, international agenda-setting organisations, and cities themselves for expert- and evidence driven approaches to multiple aspects of urban climate change and sustainability, including nature-based solutions. However, given growing interest in nature-based solutions research and practice towards questions of justice, it is important that the knowledge systems used to inform decisions about urban nature-based solutions are critically scrutinised. We use the lens of epistemic justice – justice in knowledge, with regard to how society defines a problem and the range of possible solutions – to assess nature-based solutions actions for climate adaptation and resilience across five cities: Amsterdam, Glasgow, Hanoi, Oslo, and Taipei. Our study finds common issues: the risk of quantifiable evidence about the distribution of NbS and its benefits closing down the aims of NbS strategies to meeting narrowly-defined indicators; the potential for self-defined communities of experts becoming *de facto* authorities on NbS; and the need for those tasked with implementing NbS 'on the ground' to have access to the fora and knowledge systems in which NbS strategies are developed. A key message is that more participation alone is insufficient to address epistemic justice concerns, unless it comes at a stage where a broad range of stakeholders (and their knowledges) can influence adaptation strategies and the role of NbS within them. Given the inter- and transdisciplinary nature of NbS scholarship, we argue attention must be focused on the potential for exclusion of key knowledge systems from policy and governance processes.

## 1. Introduction

Rising interest in the potential of nature-based solutions to respond to multiple urban climate and sustainability issues (e.g. Kabisch et al., 2016) is accompanied by calls for expert-, evidence- and data-driven approaches to the same climate and sustainability challenges in cities (e.g. Hsu et al., 2020; Prieur-Richard et al., 2018). Yet amidst these concomitant interests in nature-based solutions and in evidence-driven approaches to urban policy, the language and logic of nature-based solutions arguably remains a heavily techno-scientific and Western-centric approach (Escobedo et al., 2019; Shi, 2020). Recent synthesis articles hold that research in nature-based solutions and related fields tends to be dominated by journals in the ecology and environmental engineering fields (Matsler et al., 2021); by scholars from a relatively small number of countries (Escobedo et al., 2019); and by case study evidence derived from larger cities (Kendal et al., 2020). Within city contexts, it has also been argued that communities of experts can influence urban policy and planning processes through knowledge from particular disciplinary backgrounds (Finewood et al., 2019) or by promoting their own understandings of 'what works' (Dobson and Dempsey, 2019). These debates come at a time when there are calls for greater attention to the contours of urban nature in non-'Western' contexts (Basu and Nagendra, 2020; Venter et al., 2020), and also to how different kinds of academic- and practice-based knowledge about urban greening move and exert influence both within (Mabon et al., 2019) and between (Affolderbach et al., 2019) city contexts. Moreover, effective and just implementation

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of nature-based solutions is argued to require the collaboration of technical, ecological, and social knowledges (Keeler et al., 2019), and hence a plurality and inclusivity of knowledges relating to nature-based solutions within urban planning and governance processes. It is therefore vital to critically scrutinise who gets to define the purpose, benefits and evidence base for nature-based solutions, both within and between different city contexts.

The aim of this paper is hence to explore the questions of who gets to define: (a) what 'nature-based solutions' are (and not); (b) what the problems are to be addressed through nature-based solutions; and (c) what the range of acceptable and envisioned outcomes are for nature-based solutions across different city contexts. To do so, we adopt the conceptual lens of epistemic justice (Fricker, 2007) – that is, justice in knowledge, in terms of whose identities and whose experiences are included in the process of determining social problems and the range of possible outcomes. We use epistemic justice as an organising concept to understand nature-based solutions policy, planning and deployment across cities of different sizes, spanning different climatic and socio-political contexts: Amsterdam (the Netherlands); Glasgow (Scotland, UK); Hanoi (Vietnam); Oslo (Norway); and Taipei (Taiwan).

We understand nature-based solutions (NbS) according to the (IUCN, 2016) definition of "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits." However, to go into sufficient depth within the confines of a single paper, and reflecting the emphasis of the case study cities, we focus primarily on *how nature-based solutions are considered for climate change adaptation and climate resilience purposes*. In doing so, we are also mindful of the Nature-Based Solutions Initiative's guidelines for NbS for Climate Change, especially principle 4 that NbS ought to support or enhance biodiversity as a means of supporting the resilience of ecosystems in the face (Nature-Based Solutions Initiative, 2022). We understand climate resilience in terms of the ability of an urban system to be able to maintain or rapidly restore core functions in the face of external shocks and stresses and/or to be able to adapt and transform in response (Meerow et al., 2016). We therefore take into account both the climate risk reduction aspects of nature-based solutions (e.g. cooling, runoff reduction) and also the ways in which NbS can help residents to be able to respond to pressures and stresses (e.g. health, wellbeing, social connectivity).

## 2. Conceptual background

There is a well-established line of enquiry into justice within urban greening, which has addressed issues such as inequitable access to parks and urban greenery in line with socio-economic and demographic factors (e.g. Pham et al., 2012); 'green gentrification' problems of neighbourhood greening raising property prices and therefore forcing out less wealthy or empowered residents (e.g. Bockarjova et al., 2020); and the potential for urban greening initiatives to in fact have negative effects on residents via ecosystem disservices such as allergies, pollution trapping and safety concerns (Escobedo et al., 2011). Whilst much of this research has been focused on the amenity, recreational and aesthetic benefits of urban greening, (Langemeyer and Connolly, 2020) call for greater attention to justice in the context of the ecosystem services provided by urban nature across a city. Pineda-Pinto et al. (2021) add that enhancing the multifunctionality of nature-based solutions requires co-design and planning processes which consider equitable provision of multiple ecosystem functions. This call is supported by an emerging body of scholarship committed to assessing the justice implications that may arise when we think of urban nature in terms of nature-based solutions delivering ecosystem services that have the potential to provide multiple climate adaptation, resilience (and mitigation) benefits to people. Key trends identified within this literature include (but are not limited to): reduced heat island mitigation benefits from urban greenery in currently and/or historically marginalised neighbourhoods (e.g. Byrne et al., 2016; Hoffman et al., 2020); transfer of flood risk to areas with disadvantaged populations (Mabon and Shih, 2021); disproportionate distribution of investments in climate-resilient urban greening towards wealthier neighbourhoods (Shokry et al., 2020); and reduced flood- and heat-risk reduction capacity in neighbourhoods showing higher indicators of deprivation (Majekodunmi et al., 2020).

Calderón-Argelich et al. (2021) however argue that although the urban ecosystem services literature has generally assumed everyone will benefit equally from urban greening, more recent work is starting to question the justice implications that arise from the planning, management and implementation of urban NbS. It is also acknowledged that there is a need to go beyond understanding justice in NbS purely in terms of *distribution*. Recent work has pointed to the importance of fairness in contemporary and historical social, political and legislative *processes* in attaining equitable outcomes (Hoffman et al., 2020; Rigolon and Németh, 2018; Venter et al., 2020). There is also emerging research into whose identities are *recognised* within decision-making processes for the siting, protection and enhancement of urban nature (Nesbitt et al., 2019). This tripartite approach to environmental justice – spanning distribution, process, and recognition (e.g. Walker, 2012) – is broadly adopted in urban resilience and climate change scholarship as an organising framework for making sense of how inequality manifests itself across space, process and identity. Nonetheless, it has been argued that a tripartite approach of this kind – whilst useful – may circumscribe how we think about environmental justice in urban greening, and limit our opportunities to understand how residents experience injustice in urban greening (Anguelovski et al., 2020). Even within a tripartite approach, it has been argued that what 'justice' may look like in practice and how it may be achieved (especially procedural and recognitional dimensions) may differ in parts of the world with different political, social and cultural structures from the 'Western' contexts in which much of the urban greening justice literature has developed to date (Mabon and Shih, 2021).

Moreover, as outlined in Section 1, there is strong advocacy at the science-policy interface for responses to urban climate and resilience challenges which are driven by evidence, expertise and data (Hsu et al., 2020; Prieur-Richard et al., 2018). Yet Anguelovski et al. (2020: 1756–1757) hold that "often vulnerable residents' long-term knowledge of living, working, or caring for a space […] is not validated by planners and decision makers in contrast with outside experts, who use privileged positions to exercise both material and immaterial power onto an urban space." As part of better planning of NbS for just cities in an increasingly 'evidence-driven' setting, it is thus imperative that any consideration of justice is extended to pay explicit attention to whose experiences, knowledges and expertises are considered a valid source of evidence and data, and whose are excluded, when it comes to establishing the nature of climate resilience and adaptation challenges, and the role of NbS as a possible solution, within a city.

In this paper, we thus take up the challenge of Anguelovski et al. (2020) to use the lens of *epistemic justice* as a means of refining the traditional tripartite approach to environmental justice in the context of NbS (we outline how we see the different conceptualisations of justice interacting in Fig. 1). Epistemic justice, broadly speaking, is justice related to knowledge. An epistemic injustice hence occurs when an individual or group is excluded from the process of defining what a specific problem is, and what the range of possible solutions may be, on account of their identity or the kind of language and evidence they use to make their claims (Fricker, 2007). To aid our enquiry, we work with two sub-categories of epistemic justice elaborated by Fricker (2007), Anderson (2012) and others. One of these is *testimonial injustice*, which occurs when an individual or group's knowledge is viewed as being less significant on account of an aspect of their identity (for instance gender, ethnicity, occupation, professional qualifications). The second is *hermeneutical injustice*, which occurs when an individual or group's account of their experience is viewed as being less significant because it does not fit within dominant understandings of what constitutes relevant and

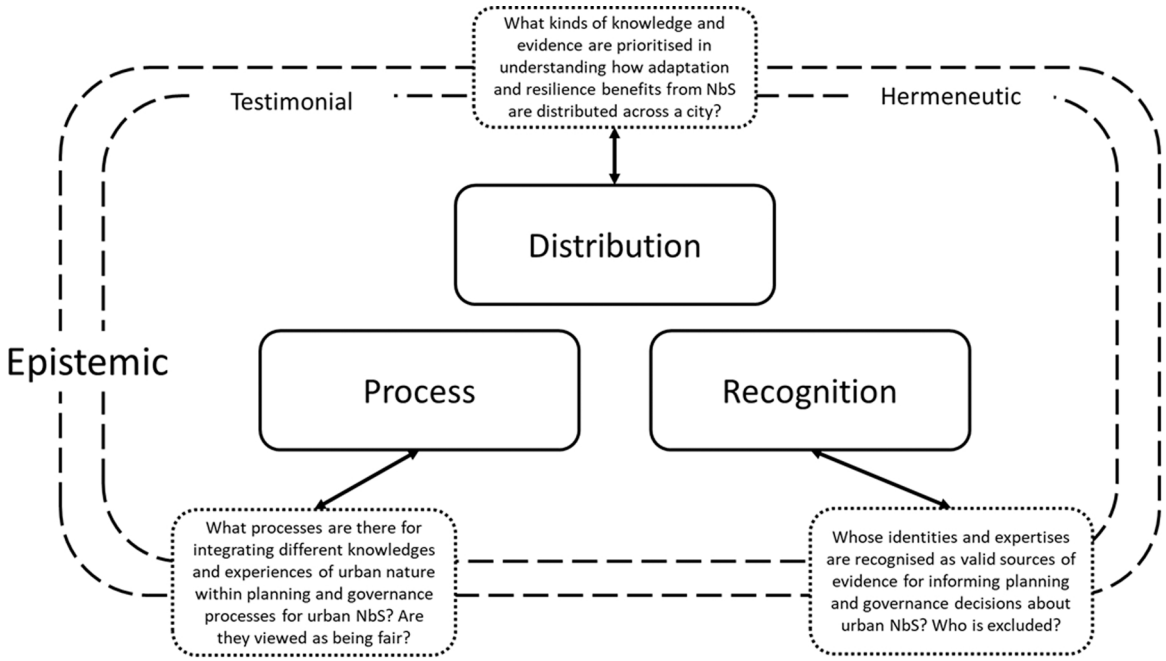


**Fig. 1.** conceptual framework situating epistemic justice in relation to tripartite approach of distribution, process and recognition, and its application to nature-based solutions.

valid knowledge, because the person or group has been excluded from participating in the process of defining the language of problems and solutions, or because those in positions of power lack the capacity to make sense of the language in which an account is framed. In an environmental context, claims to epistemic injustice can arise in at least three ways. Governments or developers may 'close down' urban policy and planning decisions, focusing on expert opinions and technical and scientific risk assessment rather than wider knowledge sources (Barbosa and Walker, 2020). Hierarchies may emerge in decision-making processes, where some kinds of knowledge and experience are seen as being more valid or relevant than others (Temper and Del Bene, 2016). Additionally, public and stakeholder knowledge may be introduced only at a stage where the technical details and the broad scope of the intervention to be adopted have been largely decided (Mabon et al., 2015).

## 3. Case study cities

We assess the potential for claims to epistemic injustice to arise in relation to the distribution, process and recognition aspects of nature-based solutions across five cities: Amsterdam (the Netherlands); Glasgow (Scotland, United Kingdom); Hanoi (Vietnam); Oslo (Norway); and Taipei (Taiwan). Given our primary interest in how questions of epistemic justice in NbS for climate adaptation play out in different socio-cultural and governance contexts, the different policy, climate, environmental and societal contexts of each city provide a useful basis for building and refining conceptual insights. Owing to the complexities of urban governance of NbS for climate adaptation, which often span different policy areas within local governments and involve multiple actors and stakeholders, cities were selected that (a) ensured a diverse set of social, political and environmental characteristics across the cases; and (b) were cities where the research team had significant recent or ongoing research activity, which allowed us to understand the context of each in-depth in a way that allowed meaningful insights to be drawn across the cases. Table 1 summarises the main characteristics of each city. It is, however, worth pointing out some of the main differences between the cases. Our cases include three European cities with oceanic or continental climates (Amsterdam, Glasgow, Oslo); and two east or south-east Asian cities with subtropical climates (Hanoi, Taipei). The case study cities also cover a breadth of political formations: established parliamentary democracy (the Netherlands, Norway); devolved parliamentary democracy with ability to set legally-binding legislation for climate change and environmental matters (Glasgow); new democracy located outside of formal UN climate agreements (Taipei); and authoritarian (Hanoi). We also assess cities with a stronger focus on heat as a climate risk (Amsterdam, Glasgow); and others with a stronger emphasis on stormwater and flooding (Hanoi, Oslo, Taipei). In our analysis, we take as a starting point city-wide strategies and rhetoric for adaptation and resilience via NbS. Where relevant, we focus on site-specific examples or cases of NbS policy and practice in our analysis in order to make specific points.

## 4. Methodology and data

Evaluation of the epistemic justice aspects of NbS in each case study city was undertaken through analysis of three sources of data for each city: (a) core urban policies and plans relevant to NbS, adaptation and resilience as outlined in Table 1; (b) existing scholarly literature produced on NbS or urban greening for each city; and (c) online news and media reports which may give insight into specific controversies around NbS. Information that was known to the research team through their prior or ongoing interview-based work in each city, and that helped to provide additional explanatory context beyond what is available in text-based sources, is cited in the Findings and Supplementary Data where relevant as personal communication. However, as this data was collected for different purposes across the cases and is therefore based on different foci and questions, it was not considered appropriate to consider it as a main source of data for the paper. Given the policy and societal complexity of each case, as well as the differing institutional arrangements, research team members with in-depth knowledge and prior/ongoing research experience for each city were responsible for collating data corresponding to each case under a common framework (see Table 2). All source material used in this paper was produced before 30 June 2021, which was the cut-off point for data collection.

The available data for each city was analysed according to a process of structured qualitative content analysis (Cho and Lee, 2014; Mayring, 2000). A list of areas of enquiry was developed to reflect key questions

**Table 1**
summary of key characteristics of case study cities.

| | Amsterdam | Glasgow | Hanoi | Oslo | Taipei |
|---|---|---|---|---|---|
| Population (urban area) (2020) | 872,380 | 598,830 | 3962,310 | 697 010 | 2602,418 |
| Population density (people per $km^2$) (2020) | 5271 | 3298 | 14,708 | 1628 | 9700 |
| Human Development Index (2020) | 0.944 (Rank 8) | 0.932 (Rank 13) (for UK) | 0.704 (Rank 117) | 0.957 (Rank 1) | 0.907 (rank 21 equivalent) (2018) |
| Climate<br>Main climate change risks facing city | Oceanic (Cfb)<br>Heat, drought, waterlogging, flooding (Gemeente Amsterdam, 2020b) | Oceanic (Cfb)<br>Increased extreme weather events; more summer heatwaves; coastal erosion; increased flood risk ( Climate Ready Clyde, 2021) | Humid subtropical (Cwa)<br>Flooding; drought; pressure on water resources (Nguyen et al., 2015) | Humid continental (Dfb)<br>Stormwater flooding, landslides, floods, sea level rise, heat waves (Oslo kommune Klimaetaten, 2019) | Humid subtropical (Cfa)<br>Flooding, landslide, drought, extreme temperature, sea level rise ( Huang et al., 2012) |
| Key policies and strategies relevant to nature-based solutions for resilience and adaptation | Green Vision 2020–2050 (2020) – identifies four priority rationales for urban greening: health, social well-being, climate adaptation, nature.<br>Strategy for Climate Adaptation Amsterdam (2020) - mentions that climate adaptation is an opportunity to create a greener and healthier city, includes a box on the green tradition of Amsterdam.<br>Annual neighbourhood plans (Gebiedsplannen), for each of Amsterdam's 26 neighbourhoods. Developed in cooperation between city, business, community, and organisations, and covers relevant issues and local needs, takes an 'Area-based approach'. | Glasgow City Region Adaptation Strategy (2020) – Intervention 9 devoted to Nature-Based Solutions.<br>Glasgow City Council Open Space Strategy (2020) – Outcome 3: Long-term resilience of the city in relation to issues such as climate change.<br>Glasgow City Council 'Our Dear Green Place' Vision for Glasgow's Parks and Greenspaces (2019)<br>GCV Green Network: Glasgow City Region green network to provide a network of connected multi-functional greenspaces.<br>Metropolitan Glasgow Strategic Drainage Partnership Surface Water Management Masterplan (2016) | Hanoi Urban Planning Masterplan to 2030 and Vision to 2050 – includes vision for green corridors and enhancing green areas.<br>One Million Trees Programme – plant one million trees towards attaining a goal of providing up to 10–11 $m^2$ of green area per person by 2020.<br>People's Committee of Hanoi Decision No. 1745 (2012) – includes awareness raising regarding climate change, particularly its impacts on people's daily lives, increasing the investments on green and smart infrastructure, and improving the people's capacity to adapt to the changing climate. 79 tasks to be completed in 11 areas of the city with 12 main programs and 82 specific projects (ICLEI-SEAS, 2020) | Oslo Municipal Plan (2015/2018) – 2015 spatial plan, 2018 societal plan – contains plans for green areas, and states planning must take climate change into account.<br>Climate Strategy for Oslo Towards 2030 (2020) – incorporates previous adaptation plans, with a vision for Oslo to become a climate-adapted and equitable city.<br>Stormwater Management Stategy (2014) and Action Plan (2016) – focus on open and local solutions to mitigate climate impacts and minimise damage and disadvantages for people, buildings, property and infrastructure, safeguard the environment and good ecological and chemical state in water-bodies, and utilise stormwater as a resource.<br>Strategy for green roofs and facades (2021) - establish more green roofs and facades to make the city greener, manage surface water, create new attractive urban spaces and facilitate energy production and lower energy consumption in buildings.<br>Project Oslo Trees (2021) – aim to plant 100,000 trees by 2030, and take better care of existing trees. Collaboration with residents, landowners, property developers and housing associations. | Taipei City Climate Adaptation Plan (2012)<br>Taipei Urban Plan: periodical overall review of Urban Planning (2018/2019) – includes disasters and hazard mapping (especially for flooding).<br>(Country-wide) Integrated urban flood management- encourage low-impact development- Taipei has had associated policies since 2003.<br>(Country-wide) Integrated runoff allocation and outflow controls in urban planning since 2019 - encourage use of greenspaces to manage runoff.<br>Smart Ecological Communities project (since 2015) - integrates green infrastructure) and disaster reduction.<br>Taipei Sponge City initiative since 2015 (Taipei City Hydraulic Engineering Office, Public Works Department)<br>Taipei Garden City Initiative since 2015 – establish community gardens on vacant public lands within neighbourhoods, schools or on rooftops. |

relating to epistemic justice in urban NbS policy and implementation, following the principles of Mayring (2000) to use the theoretical background and research question to determine the aspects of the textual material taken into account and, on this basis, develop analytical criteria. This gave a common framework to organise information gleaned from the materials available for each case study (see Table 2). Information was then extracted from relevant policy documents, scholarly literature and news articles for each city and placed against the relevant category in the analytical framework. As noted by Cho and Lee (2014), qualitative content analysis of this nature is an appropriate method of analysis for situations such as the one we have in this study, as it allows common and comparable information to be extracted across a divergent range of data sets, where the materials available for each case may differ in terms of extent, focus and content.

## 5. Findings and analysis

Our findings and analysis are guided by epistemic injustice, which occurs when an individual or group is excluded from the process of framing a problem on account of their identity, or the kind of language/

**Table 2**
guiding framework for analysis.

| Core criteria | Sub-criteria |
|---|---|
| Local policy, planning, governance and societal context | Key city-wide plans, policies and legislation driving nature-based solutions in the city (e.g. is there a city adaptation plan that mentions adaptation via NbS, does the city greenspace plan discuss climate change etc?)<br>How does the city define nature-based solutions?<br>What kinds of knowledge and evidence are used to justify decisions and strategies relating to NbS?<br>What kinds of landscape features are most commonly considered within NbS discourses in the city, especially for adaptation? (e.g. rooftop gardens, wetlands, street trees etc?)<br>Main climate change risks facing city and how NbS is claimed to address these<br>Main social justice issues facing city (and how, if at all, NbS is claimed to address these)<br>Key implementation case studies and/or site-specific controversies relating to nature-based solutions in city<br>Main urban development/socio-economic pressures on greenspace and on urban nature in city |
| Distribution | What knowledge and evidence is there about the distribution of climate risk reduction benefits of urban nature, both at a city-wide level and for specific projects?<br>What knowledge and evidence is there about the distribution of societal resilience-building benefits of urban nature (health, wellbeing, recreation)?<br>What evidence and data sources/knowledge systems are used to understand and assess distribution of urban nature and its climate resilience benefits across the city? |
| Process | Which city government departments are leading on adaptation/resilience via NbS? Are there tensions or different definitions between different government departments?<br>What kinds of participatory processes exist for nature-based solutions governance and planning (especially for adaptation)? How effective are they perceived to be?<br>Are planning and governance processes for NbS more likely to be top-down or bottom-up in the city? How do top-down city-led processes and bottom-up community-led processes for NbS differ? e.g. are there different motivations or rationales between them?<br>What claims to injustice exist in planning and governance processes for nature-based solutions in the city? E.g. Are there groups who claim the processes are unfair?<br>How are different knowledge systems and different kinds of evidence assessed and evaluated within planning processes for climate adaptation and urban nature? |
| Recognition | Are there international definitions and initiatives (e.g. European Union strategies for NbS) or particular scholarly/academic disciplines and knowledges that drive the governance of NbS for adaptation in the city?<br>Whose identities, and what kinds of evidence and expertise, (e.g. which government departments, which NGOs, which developers, which communities) are recognised within governance processes and plans for nature-based solutions within the city (again, especially for adaptation)?<br>Whose identities, and what kinds of evidence and expertise, are excluded? |

evidence they use to make their claims. We build out from the tripartite understanding of environmental justice, by looking at how epistemic aspects play out in turn in relation to distribution, process, and recognition. As the findings are by necessity narrative, Table 3 provides a summary of the most important epistemic justice issues that were found for each of the five cities.

**Table 3**
main epistemic justice findings for each city.

| | Distribution | Procedure | Recognition |
|---|---|---|---|
| Amsterdam | City government selecting definition of 'greenspace' to encompass artificial/private/sports spaces, to meet greenspace criteria. | Engagement with 'experts' to conduct dialogues and stress tests during planning for climate adaptation. Also third-sector coalitions of 'experts' who become a strategic discussion partner for city. | Self-defined independent organisation of 'experts' becomes strategic discussion partner for city on urban greening. Greening and adaptation programmes mainly top-down, with consultation/dialogue role for publics' experiences. |
| Glasgow | Foregrounding of quantitative measures of climate risk and social vulnerability, and role of NbS in climate resilience – to detriment of attention to how to attain outcomes in practice? | Prominent role in adaptation planning processes for economic and social return on investment studies – and on consultants that can undertake these – as a means of justifying NbS investment. | Communities' own knowledges and expertises engaged widely in greenspace planning, but perhaps not so fully yet for NbS implementation for climate resilience? |
| Hanoi | Focus by city government on planting large numbers of trees, rather than where trees can be located most effectively. | Influence of international consultants and overseas governments/agencies in greenspace and climate change planning. | Good expertise in climate adaptation and greenspace planning is held by individuals, but not necessarily recognised within wider governance systems. Civil society role is more oppositional, with limited consultation. |
| Oslo | Focus on economic and financial justifications for NbS, e.g. costs of inaction. | Hierarchies of knowledge in blue-green infrastructure: hydrology and landscape expertise carry more influence than biodiversity and ecological knowledge? | Systematic involvement of publics in greenspace decisions limited, assessments still rely on 'experts'; best practices not always reaching those tasked with practical implementation and maintenance? |
| Taipei | Incorporation of remote and derelict lands into greenspace plan in order to meet greenspace targets. | Academic researchers, and also experienced practitioners, engaged in developing climate adaptation, flood management and Garden City policies. These groups can set definitions of how climate issues ought to be managed. | Community university system and local government-led training classes recognise local and experiential knowledges as well as techno-scientific, and offer means of training community members in NbS stewardship. |

Before progressing to the different dimensions of epistemic justice, it is useful to summarise the local governance and planning context for NbS and adaptation in each city, and the role of knowledge and evidence within these (see Table 4). The predominance of engineering and natural science expertise in driving adaptation and NbS-related planning forward in all cases is notable, whether this is from academics at national

**Table 4**
local governance and planning context for each city, and role of knowledge and evidence in these.

| | Sectors covered in city adaptation and NbS-related plans | Role of knowledge and expertise in formation of adaptation and NbS-related plans | Stakeholder consultation – and knowledges encompassed – during adaptation and NbS plan formation |
|---|---|---|---|
| Amsterdam | Priority sectors in Amsterdam climate adaptation plan: heat, drought, rainfall, flood risk. Priority sectors in Groenvisie 2050: health, societal wellbeing, climate adaptation, nature. | Amsterdam climate adaptation strategy includes a list of sources cited, from Dutch research institutions e.g. Deltares, Hogeschool van Amsterdam, RIVM and KNMI. Groenvisie 2050 mentions research has been done on the effects of green on people, and that they are not starting from scratch but that knowledge is available and research has been done, but references not provided. List of sources mainly includes documents of the city of Amsterdam. | Climate adaptation strategy: stress tests and dialogues involving experts to understand risks in city. Surveys with residents and businesses, face-to-face meetings with contractors and story collection from communities. Groenvisie 2050: municipal survey of member organisations of Green Platform Amsterdam (NGOs, third sector organisations); and co-organised sessions on ecology, climate adaptation and health. Web dialogues with NGOs/third sector organisations and city districts, as well as discussions with residents and interest groups. |
| Glasgow | Glasgow City Region Adaptation Strategy: 11 strategic interventions: governance mechanisms; develop ability to adapt; adaptation finance; participation for most vulnerable; reflection, monitoring and evaluation; adapt for 22nd Century; early warning and preparedness; resilient built environment; nature-based solutions; research and knowledge; resilient economy. Glasgow City Open Space Strategy: focal areas on liveability; health; and resilience. | Adaptation strategy: development of climate risk register via Climate Ready Clyde drawing on internal expertise and review of existing evidence; baseline environmental and social impact report produced by private sector technical consultants; and support from charities in public policy/arts sectors in drafting strategy. Open space strategy: developed via participation in European Union-funded project spanning academia, local government and enterprises – learning via collaboration. Builds on internal audit of open spaces in city and production of open space map. Collaboration with local universities (especially on valuation of spaces) | Adaptation strategy: baseline environmental and social impact reports supported by dialogues with stakeholder groups and with communities in the region (e.g. local government, charities, observing academics). Open space strategy: engagement with communities to gather local perspectives on open space quality – systematic and qualitative elicitation of communities' views on open spaces in their locality. |
| Hanoi | People's Committee of Hanoi Decision No. 1745 (2012) – includes awareness raising on climate change, increasing investments on green and smart infrastructure, and improving capacity to adapt to the changing climate ( ICLEI-SEAS, 2020). Main principles in Hanoi Urban Planning Masterplan to 2030 and Vision to 2050: preserve and upgrade historic urban core; extend core city outwards; protect green corridors to protect agricultural land and flood control; establish satellite towns; enhance road and transport network. | Climate adaptation planning/open space: expertise from international organisations (e.g. ICLEI) and other city governments (e.g. Seoul, Singapore) shaping climate responses and open space planning practice in Hanoi. Open space: original urban planning masterplan to 2030 and vision to 2050 developed by private sector international consultants. However, also hybridisation of global 'green city' rhetoric to Vietnamese context (Leducq and Scarwell, 2020). | Community/civil society engagement in open space decisions often more oppositional or adversarial, without meaningful consultation. However, opposition to loss of green space does sometimes lead to change in strategy ( Leducq and Scarwell, 2020). International organisations and overseas agencies act as intermediaries for stakeholder and community participation – and as a channel for collecting knowledges and experiences – for climate and open space issues. |
| Oslo | Adaptation integrated within Climate Strategy for Oslo Towards 2030, which has goals of direct emissions, climate resilience, forests and land use, energy, and indirect emissions. These are achieved across 16 priority areas spread across land use, transport, building and construction, waste, energy, consumption, and climate governance. Particularly relevant to NbS is the priority area of Land Use and priority areas 1 and 2: manage forest areas to protect carbon stocks and enable adaptation; preserve and restore watercourses, fjord parks and outdoor recreation areas. Municipal Plan Oslo Towards 2030: Smart, Safe and Green. Two sections: area plan, | Climate adaptation planning draws on meteorological and climate data from national research institutes focusing in climate adaptation. Norwegian Climate Agency – and in turn research institutes and consultancies e. g. CICERO, SINTEF, Asplan Viak commissioned to produce evidence base for Oslo's climate strategy. Prominent role for water engineering and landscape architecture within blue-green stormwater planning. Less emphasis on expertise from biology and ecology? Also prominence of landscape architects in press coverage on greenspace-related issues in Oslo; and urban planning/ geography in green infrastructure sections of evidence | For adaptation planning: Climate Agency consulted with businesses, organisations, and municipal enterprises. Community and citizen engagement mainly happens on a site-specific basis through different research projects. Challenge around engaging less vocal/ visible/empowered community members, and dominance of interest groups? |

(*continued on next page*)

**Table 4** (*continued*)

| | Sectors covered in city adaptation and NbS-related plans | Role of knowledge and expertise in formation of adaptation and NbS-related plans | Stakeholder consultation – and knowledges encompassed – during adaptation and NbS plan formation |
|---|---|---|---|
| | and societal plan. Under city planning strategy, plan has 3 prority areas: change of pace in climate and environmental policy; ative and sustainable municipality; socially sustainable city with equal opportunities. | review for Oslo's Climate Strategy Towards 2030. | |
| Taipei | Taipei City Climate Change Adaptation Plan focal areas: flooding, landslide, drought, extreme temperature, sea level rise. Greenspace/NbS-related issues driven by Taipei City Urban Plan; and also Land Use Section of National Climate Change Adaptation Plan. | Climate adaptation: adaptation plan developed under leadership of team of academics from urban planning background. NbS-related issues: influence from sectors e.g. civil engineering, landscape, urban planning via expert advisory committees at city government level, however limited coordination between disciplines. | Moves towards participatory and deliberative approaches to engage practical and experiential knowledge of stakeholders and communities in decision making for the built environment in Taipei. Especially using online or blended on/offline platforms e.g. Presidential Hackathon challenging citizen groups to meet SDGs via open data; vTaiwan deliberative prototyping platform. |

institutions (e.g. Amsterdam, Taipei) or consultants from the private sector (e.g. Glasgow, Hanoi). The evidence base drawn on across the cities to justify decisions also varies, with some cities undertaking their own research on the location and potential of NbS (e.g. Glasgow), and others citing research produced by national research institutes (e.g. Amsterdam, Oslo) as a justification for adaptation action. In some cases, stakeholders' and communities' local and experiential knowledge are formally included in planning and governance processes (e.g. Glasgow, Amsterdam, Oslo). In others (e.g. Hanoi, Taipei), rich participatory processes are driven on a case- or project-specific basis by research or civil society organisations rather than as a formal requirement under planning processes.

### 5.1. Distribution

We first look at how issues of epistemic justice play out in relation to understanding the distribution of adaptation and resilience benefits of NbS across the cities. In other words, *what kinds of language and evidence – and whose knowledges – are used in making sense of how NbS benefits are distributed across the case study cities?*

A common factor across each of the cases is the predominance of quantitative measures of the extent, distribution and impact of NbS in driving policy and planning decisions. For instance, the introduction to Glasgow's Open Space strategy places statements referring to the biodiversity and green potential of the city (e.g. "112 trees per hectare", "Over 6000 species recorded in Glasgow") and climate risk (">99,000 properties at risk of flooding across wider Clyde & Loch Lomond area") as justifications for the protection and proliferation of green spaces (Glasgow City Council, 2020: 5). Oslo's climate adaptation strategy too utilises quantitative measures as a justification for action, providing an estimate of the costs of not taking action to manage stormwater (pointing to the cost of the flooding in Copenhagen in Denmark, estimated at DK 5 billion) to emphasise the need for strategies including NbS to manage stormwater in the city. Hanoi places a flagship NbS strategy very explicitly in numerical terms, the One Million Trees Programme aiming to plant one million trees towards attaining the goal of providing up to 10–11 $m^2$ of green area per person by 2020; and in Oslo too the governing political party wants to plant 100, 000 trees by 2030. Amsterdam adds a temporal dimension to these quantitative measures, by stating not only the area or number of interventions they will create, but also by when. For example the municipality will coordinate the implementation of 10.000 $m^2$ blue-green roofs, with 4 roofs implemented in 2021. In each case, these are measures which are collected and assessed by the city authorities themselves.

Quantification of the extent, distribution and benefits of NbS is of course a vital part of making appropriate decisions on the management of NbS in a city. However, epistemic justice concerns may arise when meeting numerical targets becomes an end in itself. A good example in this regard is Taipei where, for example, in order to meet a regulation in the urban plan stipulating 10 % of urban greenspace, remote and derelict lands are alleged to have been incorporated into the plan in order to meet the target (personal communication with Taipei City Parks and Streetlights Department). Similarly, it has been argued in Amsterdam that in the face of densification of urban development, the city will update its urban green standards for new build and existing areas, providing reference standards for usable greenery and ecosystem greenery (Gemeente Amsterdam, 2020a). The use of the standard within Amsterdam has been critiqued, as in one district the city seems to have classified artificial turf pitches, balcony boxes, potted plants and even athletics tracks as 'green space' in order to meet the city's green standards (Oomen, 2020).

Claims to epistemic injustice may arise here if only a small number of easily quantifiable aspects of NbS, such as area, ratio of green cover, and number of projects, are used to assess the 'success' or otherwise of NbS in a city in a way that marginalises or sidelines richer and more qualitative accounts of the benefits provided. A preference among urban governors for easily quantifiable numerical indicators of success, such as Hanoi's aim to plant one million trees to boost the area of available greenspace per person, may be especially problematic for delivery of NbS which requires understanding of multiple benefits from urban nature at the city- or landscape scale.

Quantification also plays a significant role across the case study locations when it comes to justifying which people are considered to be vulnerable and where they are located. Amsterdam, for instance, has established the 'Staat van de Stad Amsterdam' to collect systematic data on the social developments in the city under the control of Gemeente Amsterdam, collecting data on, for example, paid work, living situation, health, education and social participation (Gemeente Amsterdam, 2019). Related, the Groen Platform Amsterdam identified 40 potential locations for 'postage stamp' gardens or neighbourhood gardens, on the basis of relatively high expected impact on nature, climate adaptation, social well-being and health (Hennen and Mattijssen, 2020). This has been mapped in an inspiration map across the city (https://buurtgroen020.nl/inspiratiekaart). Glasgow City Council has likewise produced a Nature-Based Solutions Dashboard drawing on socio-economic data collected by Scottish Government (Scottish Neighbourhood Statistics) as well as open space data/GIS layers managed by Glasgow City Council; and lists public health data (e.g. "In last 10 years, obesity rates in Greater Glasgow have risen by 66 %, BMI 25 +" and "Mortality rate 15 % higher than other UK cities") as a driver for NbS actions (Glasgow City Council, 2020: 5). These quantitative socio-economic statistics are

then in cases used to identify and justify locations for NbS interventions within cities, using statistics such as a lack of green cover in Glasgow (GCV Green Network, 2022) or the socio-economic profile of the area in Amsterdam (Hennen and Mattijssen, 2020) to justify why certain locations and the people living there require NbS interventions.

Again, the use of spatial socio-economic and demographic data to understand where populations are that may stand to benefit the most from NbS interventions is itself a valuable aid to making sense of how to equitably plan NbS across a city. Where potential claims to epistemic injustice may arise, though, is if these centrally collected and quantitative measures of the characteristics of a neighbourhood – which are produced via surveys and censuses conducted by the local authority or the state – become the primary driver of identifying 'vulnerable' neighbourhoods to be targeted for NbS interventions. With this in mind, we now turn our attention to questions of whose knowledges and data are recognised in NbS decision-making in the case study cities.

### 5.2. Recognition

We now look at epistemic justice in the context of who is recognised within NbS planning and governance. The key question here is *whose identities and knowledge are recognised as making them experts in NbS, and whose knowledge systems are recognised as being significant when it comes to understanding the adaptation and resilience benefits of urban greening, and in defining research and policy priorities*. Whilst recognition and process aspects of justice may appear to overlap (Mabon, 2020), we draw a distinction between questions of who is recognised, which we address in this section, and how people are treated in planning and governance processes, which we address in the next section.

There are differences between the cities with regard to whose knowledge is prominent within the development of flagship policies and strategies. Amsterdam initiated its adaptation planning through stress tests and internal dialogues with 'experts' to arrive at an initial assessment of the risks that climate change poses to the city (Gemeente Amsterdam, 2020b). In Oslo the Norwegian Climate Agency, and in turn the CICERO Centre for International Climate Research, were commissioned to produce an evidence review for Oslo's climate strategy (Oslo kommune Klimaetaten, 2018), which was followed by a fuller evidence document containing multiple commissioned studies the following year (Oslo kommune Klimaetaten, 2019). Taipei too has influence from academic researchers and also practitioners at the early stages of its climate adaptation plan (Huang et al., 2012), integrated urban flood management, and Garden City vision (Hou, 2020). In Glasgow, by contrast, economics and social return on investment-type studies – and by extension economic consultants – have a much more visible role in key policy documents such as the Open Space Strategy, City Region Adaptation Strategy, and the Dear Green Place Vision as a means of justifying investments in NbS for adaptation and resilience. In Hanoi, international consultants and international organisations have a prominent position in influencing greenspace and adaptation planning for a 'green city' vision (Leducq and Scarwell, 2020), for instance collaboration with the French AREP group on city centre green spaces; with Singapore National Parks Board on tree planting and maintenance; and with Seoul Metropolitan Government on citizen participation via ICLEI Ambitious City Promises (ICLEI-SEAS, 2020).

The significance of these differences for epistemic justice lies in understanding how and to what effect that certain groups of people are able to establish themselves as 'experts' within each locality, and whether this may lead to other forms of knowledge being sidelined in NbS governance processes. In Taipei, for example, planning decisions over the future of the highly flood-prone and socially disempowered low-lying river island of Shezi are driven in large part by the Taipei Area Flood Control Plan, a plan for controlling flooding across the entire Taipei Basin which itself is derived from a Water Resources Planning Committee report on flood control options conducted in the 1970 s (Liao et al., 2019). Whilst there have been moves in recent years to move towards more community participation in deciding the future of Shezi, (Hsiao, 2021), the range of potential options presented to communities for discussion tend to be constrained by conditions of the overarching flood control plan and derived from hydraulic modelling studies (Liao et al., 2019). At the heart of the protracted dispute over Shezi is hence the idea that Shezi's residents and their testimonies are discredited on account of the fact they lie outside technocratic and top-down definitions of how flooding ought to be managed in the Taipei Basin. In Oslo, both planners and researchers have argued that 'hierarchies of knowledge' exist for blue-green stormwater structures, whereby expertise of, for instance, hydrology and landscape has yet received more attention than biodiversity and ecological knowledge connected to urban blue-green structures. Amsterdam has the Green Platform Amsterdam, an independent partnership of (urban and local) green organizations, initiators, entrepreneurs and resident groups. The aim of the GPA is to collate urban greening knowledge and insights and to include this in consultation with the municipality about green policy. The GPA has become a strategic discussion partner for the municipality with regard to the development and implementation of the urban green vision; and also initiates and supervises various studies in the field of urban green space.

It is already acknowledged in the literature that coalitions of experts from academia, policy and practice can work together to exert influence over urban NbS strategies (Finewood et al., 2019; Mabon et al., 2019). However, claims to epistemic injustice may arise if policy frames adopted by local governments to prioritise specific issues (Dewulf, 2013), or the actions of particular networks of people to position themselves as 'experts', lead to some fields of expertise wielding disproportionate power within NbS planning and policy to the exclusion or marginalisation of others. Hanoi and Taipei in particular illustrate how prioritisation of some types of academic knowledge and/or the excessive influence of international consultants and case studies can lead to strategies which emphasise some environmental problems over others, or lack attention to important disciplinary knowledges. If left unchecked, these claims to epistemic injustice may lead to the exclusion of valuable and diverse perspectives on what constitutes effective and equitable deployment of NbS in practice.

### 5.3. Process

We finally look at epistemic justice within planning and governance processes for NbS across the case study cities. As previous, this is closely linked to the question of whose knowledges and identities are recognised in the framing of NbS strategies, however here we focus more on the processes through which the framing and deployment of NbS happens. The core question we address here is thus: *are different identities, language and evidence embedded within NbS planning and governance processes in a way that allows them all to meaningfully define the key problems and inform the outcomes?*

One critical issue in this regard is how well different knowledge systems are able to transfer between policy-making and planning for NbS, and on-the-ground implementation. This problem is illustrated very well for Hanoi, where it was argued that the basic problem was not the lack of knowledge of climate change and NbS or the competence of planners and policymakers per se, but rather that getting technical knowledge to people tasked with implementation was contingent on opportunities for face-to-face interaction (personal communication with climate change researcher (Hanoi); personal communication with urban planning expert (Hanoi)). Similarly, in Oslo, Evensen et al.'s (2021) study with the City of Oslo's park maintenance workers showed that they did not have any formal routines for taking into account safety measures in their daily practice of maintaining green structures, despite being concerned with park attributes (e.g. vegetation height, open views, maintenance, lighting) to promote safety. On the other hand, in Taipei the community university (adult higher education) system has been argued to create a network of stakeholders in process of implementing projects and bringing local knowledges into the project teams.

For the Taipei Garden City programme in particular, the Department of Economic Development runs training classes, which are mandatory for volunteer gardeners but which offer an opportunity to connect techno-scientific, local and experiential knowledges of how to manage urban nature in practice to return multiple benefits.

What these differing observations say about epistemic justice is that those tasked with implementing NbS on the ground may not necessarily have fair and equitable opportunities to access to the knowledges they need – and want – to be able to implement NbS effectively, unless formal and open training programmes of the kind seen in Taipei for edible gardens are put in place. There is arguably a disconnect across most of the cases between the fora where expert-led knowledges are used to inform NbS policy, and which are inaccessible to many publics and practitioners, and the processes and spaces in which implementation, maintenance and stewardship happens. In Amsterdam, for instance, the vision documents on both urban greening and climate adaptation and the connected implementation programmes which are currently being drafted are more a top-down process with input via conversations held with citizens and questionnaires; and in Glasgow, whilst there is a strong trend towards community empowerment, this tends to be geared more towards gathering citizens' experiences on the quality, accessibility and usability of greenspaces (Glasgow City Council, 2020) rather than understandings of how parks and open spaces may feed into climate adaptation and resilience via a wider NbS strategy. In Oslo, greenspace decision-making has previously largely relied on the assessment and input of experts, and discussions are ongoing on how to systematically involve publics more effectively beyond required public consultation processes for some projects (Evensen et al., 2021; Lindholst et al., 2016) In Hanoi, planning processes have limited means for citizens to be consulted (personal communication with greenspace researcher, Hanoi), meaning society's role in NbS tends to be more oppositional (Gillespie and Nguyen, 2019). As such, whilst there is ever more awareness of the importance of societal participation in NbS planning and deployment across the cases, and indeed the literature more widely (Dennis & James, 2016), thinking in terms of epistemic justice suggests that this participation may need to be extended to encompass more equitable access to the fora in which adaptation and resilience issues to be addressed via NbS are framed, and more equitable access to the underpinning techno-scientific knowledge itself.

## 6. Discussion

We return to our overarching interest in epistemic justice, especially Anguelovski et al.'s (2020) call for further enquiry into questions of justice in knowledge and evidence for urban greening and nature-based approaches to resilience. We split our discussion into the two core aspects of epistemic justice proposed by Fricker (2007) and elaborated by Anderson (2012): testimonial injustice; and hermeneutical injustice.

### 6.1. Testimonial injustice

Testimonial injustice, as one sub-set of epistemic injustice, refers to situations where someone's knowledge and expertise are discredited based on aspects of their identity. The key question is thus: whose identities are given credibility and traction in NbS approaches for adaptation and resilience?

One notable finding in this regard is the hierarchies of knowledge *within* scholarly expertise that exist across some of the case studies. This can be seen in Oslo, where landscape and environmental engineering are argued to have been prioritised within blue-green stormwater management to the detriment of ecological expertise, and in Glasgow, where arguments grounded in economics (and the work of economic consultants) have a prominent role in rationales for NbS. In other words, not all evidence from across scholarly disciplines is given equal weight at the science-policy-practice interface for NbS. This reflects what has been observed elsewhere in the literature with regard to how different disciplinary expertises may compete for influence over municipal greening policy and governance (e.g. Finewood et al., 2019 on Pittsburgh, USA; Mabon et al., 2019 on Fukuoka, Japan). In the area of policy frames, it has been suggested that biases towards economic or technocratic aspects can affect how adaptation is defined in policy processes (Dewulf, 2013). In our findings, the presence of knowledge hierarchies in NbS governance supports existing work, which holds that different types of knowledge and expertise can be used selectively by policy-making institutions to enforce existing policy frames (e.g. Vink et al., 2013 on water policy and flood defences in the Netherlands). Recent scholarship on NbS has advocated meaningful integration of multiple knowledge systems across the natural, physical and social sciences given the social-technological-ecological nature of NbS (Keeler et al., 2019). Our findings indicate, however, that potential for claims to epistemic injustice may still arise at the science-policy-practice interface if some disciplines – and the individual and institutional actors representing them – are given or exert undue influence over policy formation process due to their disciplinary identities.

A second related finding is the potential for networks of scholars and practitioners to wield disproportionate influence over local government policy and implementation for NbS. This may happen because the worldviews that underpin policy processes prioritise some forms of knowledge over others; or because expert communities position themselves as de facto experts on urban greening in a locality. These networks have characteristics reflective of those seen in the communities of practice (Bendt et al., 2013) and epistemic communities (Finewood et al., 2019) literature for urban greening, in that they have a shared interest in particular techniques and approaches to urban greening and a shared aspiration to influence policy through their expertise. Such expert communities are particularly prominent in Amsterdam and Taipei, where they have become almost go-to organisations for the local government for some aspects of NbS policy. Moreover, as per Vink et al. (2013) it may be that policy frames - such as the emphasis in Glasgow on economic uplift and new economic models as a means of resolving societal challenges - lead to some forms of knowledge and expertise being privileged over others. One notable distinction between the cases, perhaps reflective of the different development states between the cases, is that whilst the self-identifying expert communities within Amsterdam and Taipei consist of actors from within the city, in Hanoi the coalition of experts seeking to steer municipal NbS policy is influenced heavily by overseas and international urban greening 'experts' (e.g. ICLEI, Seoul Metropolitan Government, the French-supported PRX-Vietnam) who interface with locally-situated experts and practitioners. These questions of who is recognised as an 'expert' by a municipal government, and what the knowledges and case studies are that these expert communities may impart to a local government, are significant in an age of NbS policy mobilities (Affolderbach et al., 2019) where more and more cities seek to embed themselves within global city networks (Acuto and Leffel, 2020). Our findings indicate that local communities of practice exerting influence over policy may play a significant role in determining which international cases are used as exemplars or best practice guides for municipal governments, or which partner cities are engaged in mutual learning and exchange practices.

### 6.2. Hermeneutical injustice

Hermeneutical injustice, as a second sub-set of epistemic injustice, concerns claims to injustice based on discounting someone's knowledge on the basis of the kinds of language and 'evidence' they use to narrate their experience. The critical question for our purposes is therefore: are particular kinds of evidence prioritised within municipal NbS processes to the exclusion of others?

As outlined in Section 5.1., there is a heavy emphasis across the cases on quantitative rationales for NbS deployment and enhancement. In each city, prominence is given to quantitative measures, standards and targets for urban greening for adaptation and resilience in each city.

Such quantification is of course an important part of an evidence-based approach to NbS within a city, both in terms of understanding ecosystem benefits across a city and possible trade-offs (Meerow et al., 2019) and also in understanding who may be at greatest risk from climate change and where they might be located (Pearsall, 2010). However, our findings also show some risks associated with an uncritical or excessive focus on the inclusion of numerical forms of 'evidence', which may themselves lead to claims of hermeneutical epistemic injustice.

One such issue is the danger of quantitative targets (for instance, aims to provide a certain area of greenspace per person) becoming ends in themselves, resulting in policies and practices geared towards meeting targets rather than understanding how to provide a breadth of adaptation and resilience benefits via NbS. This is demonstrated by allegations of Taipei incorporating new spaces into the city greenspace inventory to reach the 10 $m^2$ of greenspace per person target, Hanoi arguably planting trees in sub-optimal locations (such as central reservations of roads) so as to improve their green coverage ratio on paper, and Amsterdam being accused of incorporating synthetic grass and athletics tracks into green space in one particular district in order to retain greenspace standards in the face of densification. An alternative strategy in this regard may be the kind of outcome-based adaptation and greenspace planning adopted by Glasgow City Region, which has an intervention devoted to NbS in its adaptation plan (Climate Ready Clyde, 2021) and an outcome for long-term resilience in the city's open space strategy (Glasgow City Council, 2020). Another concern is that the financial rationales for NbS as a climate risk reduction strategy, for instance those seen in Glasgow and Oslo to estimate the financial value of damage that may be caused by *not* adopting NbS, may be a powerful tool in getting the attention of urban policy-makers, but may also risk reproducing financial logics which have led to poorer/more disadvantaged neighbourhoods being left out of green adaptation initiatives in the US context (Hardy et al., 2017; Shokry et al., 2020). Furthermore, an emphasis on socio-economic data sets as drivers for determining priority areas for NbS and adaptation interventions (such as the data collected in Amsterdam) may leave limited room for residents' own qualitative and embodied accounts of living with urban green spaces within the evidence base that informs municipal NbS planning decisions.

The imperative to move beyond easily measurable outputs as indicators of success is of course not confined to NbS. The Impacts, Adaptation and Vulnerability Working Group 2 report of the IPCC's Sixth Assessment cycle, for instance, recognises the value of qualitative accounts of the relationship between climate change, development and security (see especially the chapter of Schipper, Revi et al. (2022). In the context of green infrastructure, Hislop et al. (2019) argue for using qualitative yet structured indicators to assess the quality of a policy process, arguing that structured qualitative assessment of policy quality is especially important for green infrastructure and nature-based approaches, where consensus on what constitutes 'good' policy may still be emerging and where ideas of what 'success' looks like may be context specific. Potential for qualitative and narrative accounts to be sidelined – and hence for claims to hermeneutical injustice to arise – may be especially acute if the quantitative data that drives municipal NbS decisions is derived from centrally-held data repositories (e.g. census data, GIS databases) which are not accessible to or influenced by residents themselves. Attention to qualitative and narrative accounts of NbS and climate resilience is also an important aspect of the third NbS Initiative principle, to respect local knowledges and work in partnership with local communities (Nature-Based Solutions Initiative, 2022).

A second insight from our findings is that more participation is not in and of itself sufficient to redress issues of hermeneutical (or indeed testimonial) epistemic injustice. We can see from Glasgow, Amsterdam and Oslo, and also increasingly Hanoi, that opportunities do exist for residents and for civil society actors to feed into NbS plans. Legislation may increasingly mandate fuller and earlier public engagement on NbS issues and urban planning more broadly, as is the case in Oslo and Glasgow. However, evidence from Glasgow, Amsterdam, Oslo and Hanoi indicates that citizen participation often remains restricted to feedback on site-specific urban greening initiatives, for instance assessing preferences for access and quality of green spaces rather than feeding into how city's climate challenges – and the role of urban greening in solving them – may be addressed. Reflecting Puppim de Oliveira and Fra.Paleo (2016) and their argument for the necessity of quality rather than quantity of participation, claims to epistemic injustice may arise if, in spite of participation opportunities, residents still feel excluded from the process of determining how and to what extent NbS is considered an adaptation and resilience solution for their city more widely. By contrast, Taipei's Garden City programme (although focused on community gardens as opposed to adaptation) and also the city's online and blended platforms such as vTaiwan (https://info.vtaiwan.tw/) offer an insight into what participation may look like that grants equitable engagement with different knowledge systems. Such systems allow techno-scientific, local and experiential knowledges to be considered together in the process of establishing policy problems and translating policy rhetoric into practice. These platforms do not mean 'anything goes', rather they may help to sidestep claims to epistemic injustice by acknowledging and respecting how local, embodied and experiential knowledges can be important in turning NbS policy and rhetoric into deployment.

In sum, thinking in terms of hermeneutical epistemic injustice and the importance of fora which recognise different kinds of evidence indicate that meaningful participation and engagement in knowledge processes, in a way that allows access and interchange between different knowledge systems, are more important than the sheer number of participation instances for NbS in a locality.

### 6.3. Policy implications

We draw the following policy suggestions from our findings and subsequent discussion:

- There is significant enthusiasm at present globally for enhancing green coverage within cities to adapt to climate risks. C40 Cities' Urban Nature Declaration, for instance, commits cities to having 30–40 % of total built-up city surface area as green space by 2030 (C40 Cities, 2021). However, our findings indicate that the good intentions of such targets can become ends in themselves and lead to outcomes that are not optimal. Alongside such goals, there may thus be value in outcome-based approaches to adaptation via NbS. Outcome-based approaches are those which emphasise the intended effects and societal impacts of policies and actions, as opposed to meeting a narrow set of numerical targets. Outcome-based approaches can allow room for multiple knowledges and avoid a focus on planning actions being done to primarily meet quantitative targets. As NbS policies with an explicit focus on adaptation are still emerging, it is also important to assess the quality of plans and policies, and to recognise that the most appropriate NbS outcomes will depend on the local context. A good example in this regard is Glasgow City Region's Adaptation Strategy and Action Plan, which includes a cross-cutting 'intervention' that has the goal of delivering NbS for resilient ecosystems, landscapes and neighbourhoods;
- Across the cases, there is good evidence that communities and less empowered stakeholders have opportunities to engage with NbS proposals via consultation and engagement exercises. What is less clear (and we acknowledge this may be a limitation of the methods and data available) is how well these engagement and consultation processes are able to integrate local and experiential knowledge into the evidence base that is used to shape NbS plans and strategies from an early stage. Consultation strategies developed by planning authorities hence ought to consider approaches that can be used to capture narrative or qualitative accounts of places, which might not otherwise be incorporated as part of the evidence base for NbS planning;

- Our findings also show that even within seemingly 'objective' expert- or evidence-driven processes, particular knowledges and groups of actors may dominate processes. It is thus imperative to ensure that expert advisory panels maintain a diversity of expertises and academic perspectives. Whilst moves such as the Edmonton Declaration which promote the engagement of cities with scientific expertise to guide climate responses are welcome (City of Edmonton, 2018), it is vital that such approaches do not tend to the dominance of natural science perspectives and the sidelining of expertise from the social sciences, arts and humanities (as well as from outside academia). Actions such as open calls for recruitment for multi-actor expert panels may be one way to ensure this diversity and avoid inadvertent influence from epistemic communities or communities of practice on NbS policy.

## 7. Conclusion

We have used the lens of epistemic justice – justice in knowledge and in how society makes sense of a problem and its possible solutions – to present an approach to understanding justice in urban nature-based solutions that builds on the extant body of research into the distributional, procedural and recognitional aspects of justice in urban greening globally. Despite the social, environmental and political differences between the case cities, we found a number of commonalities across the cases. In terms of the epistemic dimensions of distribution, we found that a strong emphasis on quantifiable forms of knowledge in understanding benefits of NbS across space can lead to measures and targets becoming ends in themselves, with policies being designed to meet quantifiable and measurable targets rather than understanding the city-wide holistic benefits of NbS strategies. In this regard, outcome- or mission-based approaches to NbS may offer a way for different ways of knowing to co-exist in a more equitable way. As far as the epistemic dimensions of recognition are concerned, across most cases we noted that not all kinds of scientific 'expertise' are granted equal weight, and that self-defining communities of 'experts' may exert influence over municipal governments and promote particular foci, methods and reference cases of best practices reflecting their own experiences and interests. This may become an epistemic justice issue if other communities of experts in a locality receive comparatively less attention as a result. Finally, with regard to the epistemic aspects of process, we found that more opportunities for public participation in urban greening planning and governance will not necessarily reduce the potential for claims to epistemic injustice, if participation comes at a stage or in a form where residents' experiences and knowledges are not able to substantively alter the way in which the city's adaptation and urban nature vision is developed.

To return to our initial concern with evidence-, expert- and data-driven approaches to urban sustainability and climate change, let us be clear: working towards epistemic justice within nature-based solutions does not mean 'anything goes' with regard to what is relevant and appropriate knowledge. Climate change poses a very real risk of harm to people, and a comprehensive understanding of how environment and society interact at a city- or even landscape scale is necessary if nature-based solutions are to be able to reduce these risks. Rather, it is precisely because nature-based solutions draw on such a breadth of knowledge systems that it is vital we remain attuned to the potential for epistemic injustice and the implications of excluding some ways of knowing for effective and equitable adaptation responses, and do not inadvertently or otherwise narrow down the range of knowledges and expertises in research, planning and deployment processes for urban NbS.

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## CRediT authorship contribution statement

**Leslie Mabon:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing. **Line Barkved:** Conceptualization, Formal analysis, Investigation, Data curation, Writing – review & editing. **Karianne de Bruin:** Conceptualization, Formal analysis, Investigation, Data curation, Writing – review & editing. **Wan-Yu Shih:** Conceptualization, Formal analysis, Investigation, Data curation, 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.

## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2022.07.025.

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