

Just and inclusive enough? Designing inclusive NBS to support communities in their just transition towards sustainability and resilience

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ABSTRACT

Nature-based Solutions (NBS) are increasingly promoted as a strategic concept and practical approach to tackle current societal challenges, including climate change, biodiversity loss, and issues related to human health and well-being. Yet, ensuring that NBS are inclusive, just, and empower communities for decision-making remains insufficiently addressed in practice. This study, therefore, aims to a) critically review existing frameworks and approaches to NBS, with a focus on inclusivity, justice, equity, and empowerment; b) conceptualize their interlinkages and highlight their contribution to sustainability transition, and c) propose a comprehensive practitioner-oriented framework with recommended actions, measurable outcomes, and adaptive steps. A targeted semi-systematic literature review has been conducted to identify existing approaches and map knowledge gaps (e.g., current frameworks are often fragmented, lack practical applicability, and are not structured in a practitioner-friendly way). To address these gaps, the study introduces a comprehensive framework and operational guidelines for NBS researchers and practitioners, ensuring meaningful integration of inclusivity, equity, and justice throughout NBS processes. The study links inclusive NBS with just sustainability transitions defined as long-term, structural shifts that restore ecosystems while promoting social equity. It identifies three core principles: leaving no one behind, ensuring equitable distribution of NBS benefits and reduction of burdens, and fostering community empowerment through inclusive, multi-level governance. The resulting framework is structured around four thematic areas: capacity building, stakeholder involvement, inclusive NBS design, and fair benefit distribution and burden reduction. While acknowledging limitations (e.g., data scarcity and context-specific variability), the study offers actionable guidelines and reflective considerations to support researchers and practitioners in implementing inclusive NBS as drivers of more equitable transition towards sustainability and resilience.

1. Introduction

In the last decade, nature-based solutions (NBS) have become increasingly recognized as both a concept and a practical approach within the fields of sustainability, resilience, and spatial planning [1,2,3,4]. NBS are defined as “actions to protect, manage and restore natural or modified ecosystems, which address societal challenges, effectively and adaptively, providing human well-being and biodiversity benefits” [5]. As an umbrella concept, NBS integrates key principles from various

fields, including ecosystem-based adaptation, ecosystem-based mitigation, ecosystem-based disaster risk reduction, low-impact development, water-sensitive design, ecological restoration, ecosystem services, and blue-green infrastructure (BGI) [6,7]. Therefore, the NBS concept builds on the following fundamental aspects: addressing societal challenges by leveraging nature; using natural processes and functions (and later ecosystem services); embeddedness in the local context and landscape (locally adapted); cost- and resource-efficiency (especially, in comparison with conventional engineering/grey solutions); multifunctionality;

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fostering resilience; and co-creation approaches [8,9–12]. Lately, NBS have also been understood as an approach that hold potential to promote transformative change, leading to sustainability and resilience outcomes for both people and nature through participation and empowerment [2,13–15].

There is evidence on the effectiveness and critical value of NBS in addressing the socio-environmental challenges (e.g., extreme weather events, soil and coastal erosion, biodiversity loss, environmental pollution, and rises in sea level) faced by communities worldwide [14,16,17]. Other challenges relate to increased pressures from intensified urbanization and tourism, as well as changes in traditional and cultural practices [18,19]. Thus, it is crucial to develop innovative solutions and strategies that simultaneously support biodiversity, promote sustainable livelihoods of urban and rural communities, and enhance ecosystem and human health. Various NBS (e.g., urban and peri-urban parks, community gardens, green roofs and walls, ecological restoration of wetlands, establishing multi-use protected areas, nature-based tourism interventions) have been implemented, demonstrating their effectiveness in tackling these challenges [20,17]. Many studies and reports emphasize NBS as a valuable alternative to the traditional (engineering/grey solutions) approach, distinguished by shifting ecosystem management from conventional “Building in Nature” to “Building with Nature” [18, 20–25]. The studies also highlight the usefulness of the IUCN Global Standard for NBS [11] in regard to planning and implementation of NBS at different scales and in various contexts [26,27]; Seddon et al., 2021; [15].

Recent reports and handbooks [3,18,28] recognize NBS as an innovative approach to socio-ecological adaptation and resilience, encompassing all three dimensions of sustainability (i.e., social, environmental, and economic). For example, NBS address key objectives such as climate change adaptation and mitigation, meanwhile providing a wide range of environmental, social, and economic co-benefits (e.g., habitat creation, ecosystem restoration, soil protection, enhancing place attractiveness, improving health and quality of life, creating green jobs, promoting social integration) [1,10–12,29–34].

In contrast to traditional concepts and approaches that focus solely on protecting, preserving, and restoring ecosystems, NBS rely on co-creation, multi-stakeholder collaboration, and the integrated delivery of social, ecological, and economic benefits in the planning, design, and implementation of solutions. This holds the potential to promote multifunctionality, strengthens social inclusion, and helps foster new forms of urban commons [3,31,35,32,36]. To avoid worsening social inequalities, NBS realization should address **three essential pillars** that are widely discussed in academic literature and practice-oriented frameworks: inclusivity, justice, and equity [37,38,39,40]. **Inclusivity** refers to the meaningful involvement of all relevant stakeholders, particularly those who are often marginalized or underrepresented (e.g., Indigenous Peoples, women, youth) in the design, implementation, and governance of NBS projects. Inclusivity ensures that multiple social, cultural, and economic perspectives, knowledge systems, interests, and needs are considered. This, in turn, will lead to solutions that are socially acceptable, context-specific, and more effective in achieving intended outcomes, including enhanced implementation success (acceptance, adoption, and sustained use) and improved results across social, ecological, and governance dimensions [6,11,41,36]. **Justice** encompasses three key dimensions: procedural justice (meaningful participation and fairness in decision-making processes), recognition justice (acknowledgment and respect for diverse knowledge systems and cultural values), and distributive justice (equitable sharing of ecological, social, and economic benefits and reducing burdens resulting from NBS) [37,42]. Ensuring justice means that NBS do not exacerbate existing inequalities or create new harms for vulnerable populations [39,40]. **Equity** relates to fairness in access, participation, and outcomes in NBS projects. It recognizes differences in power, resources, and vulnerability and seeks to provide tailored support to achieve fair outcomes [3,8,10, 37,43]. In practice, equity in NBS might involve compensating

communities disproportionately affected by environmental risks, ensuring equal access to ecosystem services, or designing projects that reduce social and ecological disparities [37].

Nevertheless, the assumption that participation guarantees a fair distribution of benefits is desirable, yet overly simplistic. As critical studies argue, participatory processes are not inherently equitable; they are often shaped by entrenched power asymmetries, conflicting interests, and structural barriers [42,44–46]. This underscores the need for deeper engagement with justice and community empowerment as fundamental yet underexplored challenges in NBS research and development. In this context, community **empowerment** builds on and extends the three established aspects of justice and is often considered a fourth dimension or an outcome of justice. Empowerment is a process of strengthening the capacity of communities to exercise agency, influence governance, and co-produce solutions that shape their lives and environments [47,48]. Although earlier studies have touched upon this topic (e.g., [12,32,49]), the complex and often non-linear trajectories of embedding inclusivity, justice, equity, and empowerment within NBS realization remain poorly explored or fragmented. Thus, a more systematic integration of these pillars into NBS projects could meaningfully improve NBS design, implementation, and evaluation, fostering equitable and transformative outcomes while equipping practitioners with concrete, actionable guidance to operationalize just sustainability transitions. By **just sustainability transitions**, we refer to transformative societal changes that not only operate within ecological limits but also actively address inequities and promote fairness across social, economic, and environmental dimensions [28,44]. Viewed through this lens, such a justice-oriented perspective is urgently needed in the context of NBS, which are often presented in overly technocratic or apolitical ways, downplaying aspects of governance, power imbalances, inequality, and conflicts [42,44,49]. Techno-centric approaches that focus primarily on technical solutions (i.e., separate environmental and social aspects) without integrating them into societal and policy systems lack attention to the socio-political and power-laden dimensions that shape sustainability outcomes [50]. As a result, although NBS promise inclusivity and fairness, in practice, they may reproduce or reinforce existing inequities if the underlying socio-political dynamics are not addressed [37,40]. Positioning NBS within this frame allows us to move beyond neutral or technocratic approaches and critically examine their role in fostering justice and equity within the sustainability transition. These transitions involve long-term, structural shifts towards more sustainable societal systems, encompassing profound changes in actions, thinking, organizations, institutions, and values [5,11,13,51,52]. Other studies also recognized the important role of NBS in accelerating just sustainability transitions and community resilience agendas [13,53,54]. Such NBS-driven transitions have been tested and explored through experimental platforms like living labs [32,55,56], resilience labs [57], coastal transition labs [17], sustainability transition labs [58], and real-world laboratories [59]. These settings enable collaborative, place-based experimentation and learning across various sectors and disciplines.

Despite the growing number of research, practical initiatives, and programs on NBS, the focus has been, in most cases, on the scientific, technological, and innovative aspects of their development. Far less attention has been given to embedding inclusivity, justice, equity, and empowerment in ways that are actionable and applicable for NBS researchers and practitioners. Moreover, existing frameworks remain insufficiently capable of providing a comprehensive overview and practical guidance for navigating the complex trade-offs and interdependencies between inclusivity, equity, justice, and empowerment during the NBS realization process. Empirical evidence, including the prior authors' experiences, shows that these aspects are essential to understanding power dynamics within the NBS co-creation process, the distribution of benefits among different societal groups, and the potential of NBS to reinforce or transform existing inequalities and injustices [60–62]. A growing body of literature similarly emphasizes the urgency

of making NBS processes more inclusive, equitable, and just [36–38,40, 43,45,49,63].

To address these issues and promote our approach of “Building with Nature and People”, this study attempts to reveal the main principles and develop a comprehensive framework and practical guidelines for designing and implementing NBS that address inclusivity, justice, equity, and empowerment while contributing to sustainability transition. Thus, the developed research aims to:

- a) critically synthesize and assess existing approaches and frameworks to planning, design, implementation, and evaluation of NBS, with particular attention to how they address inclusivity, equity, justice, and empowerment;
- b) clarify and conceptualize the interlinkages between the former terms in regard to NBS and highlight how they support just sustainability transition; and
- c) develop and propose a comprehensive, practitioner-oriented framework and guidelines, including recommended measures, measurable outcomes, and adaptive steps for different thematic areas, to support the integration and operationalization of inclusivity, justice, equity, and empowerment throughout the NBS lifecycle.

Building directly on the gaps and bringing together the dispersed insights identified above, the proposed framework and guidelines are the paper’s central contribution, aimed at guiding practitioners in designing and delivering inclusive NBS that support just sustainability transitions.

2. Methodology

The conducted research included three stages: 1) exploring, reviewing and organizing current literature to identify how it addresses (or fails to address) aspects of inclusivity, justice, and empowerment within the NBS lifecycle and to reveal conceptual and practical gaps; 2)

connecting insights from the literature to broader debates and finding a nexus between NBS, inclusivity, justice, equity and empowerment and how they contribute to sustainability transition, thus laying the theoretical foundation for the paper’s main contribution; and 3) developing a comprehensive, practitioner-oriented framework and guidelines to support the integration of these aspects in NBS realization (Fig. 1).

Stage 1 focused on systematically identifying, reviewing, and evaluating existing approaches and frameworks related to inclusivity, equity, justice, and empowerment in the entire NBS lifecycle. For this purpose, a targeted semi-systematic literature review has been applied that combined aspects of systematic and traditional narrative review methods [64–66] (more details are provided in Fig. 2). The review included peer-reviewed scientific publications (from ISI Web of Science, SCOPUS, and Google Scholar) and grey literature (project reports, policy documents, notes, websites) published between 2000 and 2024, selected based on keyword matching. This period was chosen to capture the emergence and evolution of NBS as a recognized concept and practice in sustainability research and policy, reflecting the increasing attention to transformative, inclusive, and justice-oriented approaches over the past two decades. Searching for grey literature was done via Google Scholar and other sources (e.g., NBS-related platforms and project websites), using the same keywords. As emphasized by Selje et al. [64], this methodology helps to define key issues from the literature discourse and deepen the narrative review. Moreover, this review reveals context-specific features and aligns studies from various disciplines with the research scope and directions [65,66]. The search strategy was organized around the following keywords:

- inclusive OR inclusivity OR leave no one behind, AND
- NBS OR nature-based solutions OR nature based solutions OR nature-based approach, AND
- just sustainability transition OR justice OR sustainability transition OR justice OR just, OR social justice OR environmental justice, AND
- equity OR fairness OR fair OR equal, AND

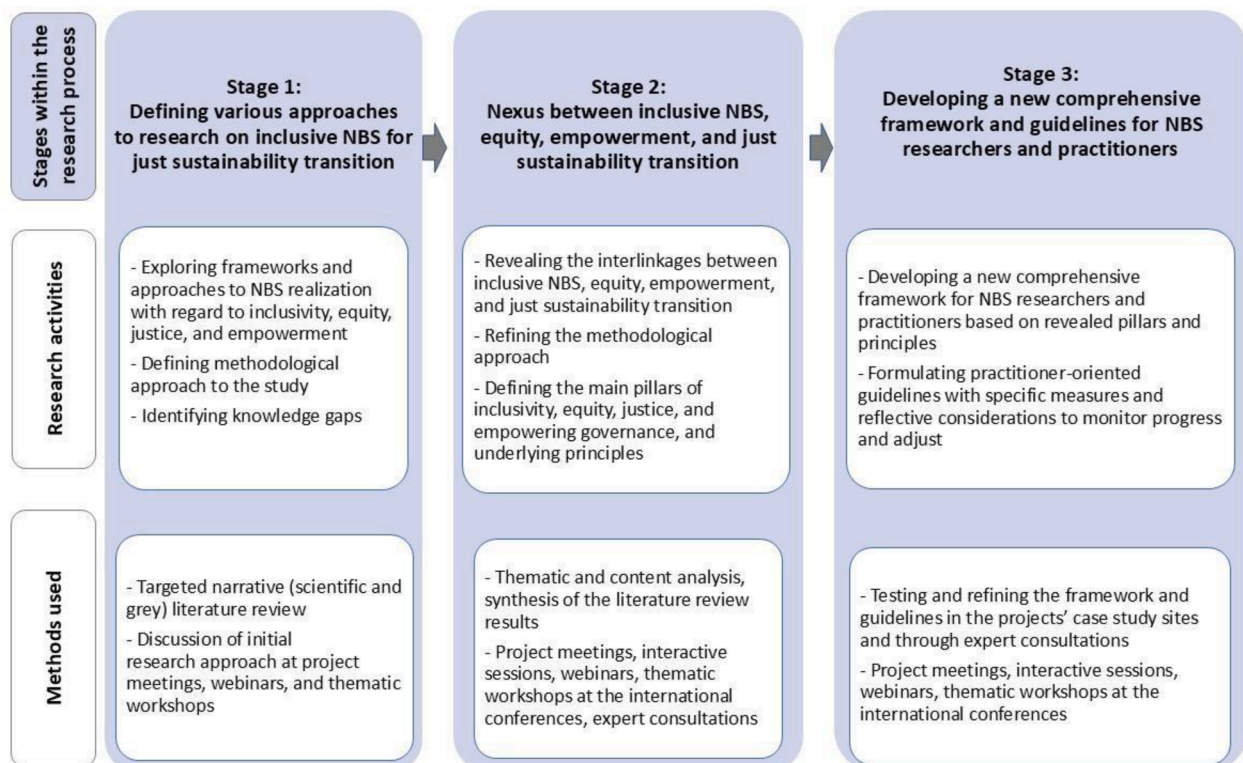


Figure 1. Methodological approach developed and used in the study: from a critical literature review on inclusivity, justice, and empowerment in the NBS lifecycle, through linking these themes to sustainability transition debates, to a practical framework for integrating them into NBS projects.

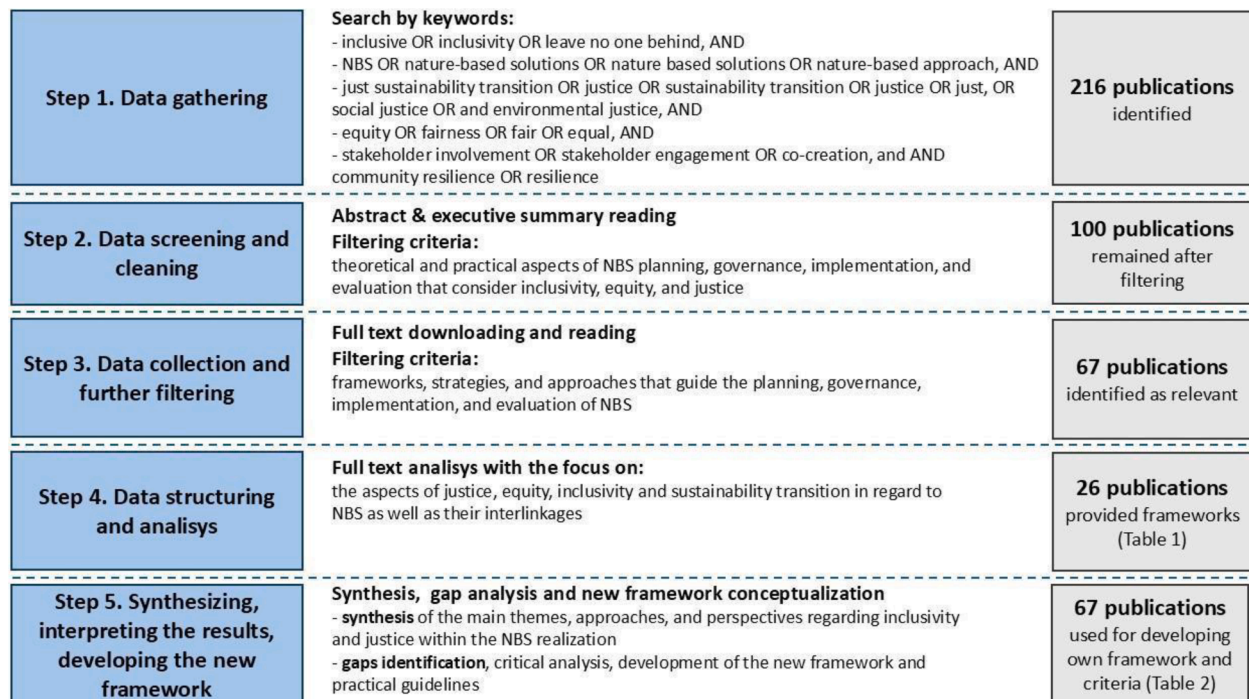


Figure 2. Steps within the literature review.

- stakeholder involvement OR stakeholder engagement OR co-creation OR participation, AND
- community resilience OR resilience.

From 216 initial titles and after filtering and removing 15 duplicates, a curated set of 100 sources (both scientific and grey literature) was compiled, focusing on the theoretical and practical aspects of NBS planning and implementation that consider the aspects of inclusivity, equity, justice, and empowerment. This selection was made by reviewing abstracts and executive summaries. To ensure objectivity and reduce potential bias, the authors engaged in mutual moderation and critical review of each other's findings. The further full-text analysis of the selected publications revealed that only 67 of them are relevant for the purpose of this study. This analysis also helped synthesize the main themes, approaches, and perspectives regarding inclusivity, equity, justice, and empowerment, and their contribution to a just sustainability transition through NBS. It was revealed that out of 67 reviewed publications, only 26 proposed specific frameworks or structured approaches for planning, governance, implementation, and evaluation of NBS and explicitly addressed the forementioned aspects. Publications lacking a structured framework or sufficient detail for practical application were excluded. We used a thematic/content analysis that helped to identify, assess, and report on these perspectives and their interlinkages with NBS, as well as to textually interpret the findings [65]. Through in-depth analysis and coding of keywords, the recurring themes were distilled following the approach of Saldana [67]. Based on this coding of the identified qualitative literature, three pillars – inclusivity, justice/equity, and empowering governance – were identified as relevant to all the reviewed publications. For example, Anguelovski & Corbera [42] propose a justice-centred NBS model to avoid “nature-enabled dispossession,” emphasizing equity, social inclusion, and governance transparency. Kabisch et al. [12] and Boyland et al. [37] explicitly call for inclusive, equitable, and socially just NBS design and implementation. Cooper et al. [68] show that exclusionary governance and lack of stakeholder inclusion undermine NBS effectiveness and social legitimacy. These and other studies consistently highlight that ecological or technical aspects of NBS alone are insufficient; therefore, social and

governance dimensions should be considered to realise NBS as fair and sustainable interventions. Each of the reviewed publications was systematically analyzed across these three overarching pillars, which informed the development of our comprehensive practitioner-oriented framework.

The *second stage* focused on uncovering and critically analyzing the conceptual connections between NBS, inclusivity, equity, empowerment, and just sustainability transitions. Following the review, a thematic and content analysis [65] was conducted to identify recurring themes, theoretical perspectives, and principles across the literature. Through coding of literature, patterns were made visible, and three pillars could be identified. Particular attention was paid to how these three pillars shape the sustainability transition. This synthesis allowed to reveal the principles underpinning these pillars and significant (primarily operational) knowledge gaps, including the fragmented nature of existing works and their limited practical applicability. Addressing these gaps formed the basis of the *third stage*, in which we developed a new comprehensive framework and practitioner-oriented guidelines. Their primary goal is to specifically ensure that **pillars** of inclusivity, equity, justice, and empowering governance, along with their underlying **principles**, are fully considered in the entire NBS lifecycle (*stage 3*; Fig. 1). The guidelines include specific practical **actions/measures** and reflective considerations on monitoring of outcomes and incorporation of adjustments/adaptive steps, guiding practitioners through the NBS process and ensuring conditions that support inclusivity, equity, justice, and empowerment.

The new framework and guidelines for practitioners have been discussed with experts in the field of NBS realization and sustainability transition. Moreover, the guidelines are supported by the outcomes and experience from co-creation with the communities within different NBS-related projects (i.e., <http://www.connectingnature.eu>, <http://www.reconnect.eu>, <https://empowerus-project.eu/com>). Importantly, expert consultation and practitioner feedback were systematically integrated throughout all research stages, and their feedback directly informed refinements of the framework and guidelines, strengthening both their conceptual robustness and practical usability. The involved experts included researchers with backgrounds in sustainability science,

environmental governance, urban ecology, urban and landscape planning, and social sciences, as well as practitioners, policy professionals, and civil society representatives (NGOs) engaged in design, implementation, or governance of NBS at local, regional, and international levels. The main principles for selecting experts were their interdisciplinary background and expertise in developing inclusive NBS where ecological performance, social equity, and governance dimensions must be addressed simultaneously. Specifically, experts provided insights on gaps in inclusivity and governance aspects, recommended clearer categorization of thematic areas and pillars, and suggested improvements on implementation and applicability across diverse socio-ecological contexts and governmental sectors. These contributions helped to adjust the structure of the framework, clarify definitions, and improve guidelines on operationalizing each pillar, ensuring they are both comprehensive and actionable for NBS researchers and practitioners. In second and third stages (Fig. 1), the proposed approach and guidelines were also presented to and discussed with a broader research community (including inter- and transdisciplinary experts) at various international conferences (e.g., 7th URBIO Conference “Integrating Biodiversity in Urban Planning and Design Processes”, 28-30 November 2022, Leipzig, Germany; “Sustaining, knowing, and ‘living’ the Blue? Coastal communities as places to belong across generations”, Trondheim, Norway, 15-16 June 2023; 5th ESP Europe Conference “Ecosystem Services: One Planet, One Health, 18-22 November 2024, Wageningen, the Netherlands; 8th URBIO Conference “Urban Biodiversity and Design with local communities”, June 24-26 2024, Columbia, USA; Dresden Nexus Conference 2025: “The Future of Resources, Resources for the Future”, 8-10 April 2025, Dresden, Germany; 4th SURE World Conference “Cities Under Global Social Transformations: Embracing Change for a Greener Future”, 16-19 July 2025, Istanbul, Turkey), and project-related workshops/meetings. These experiences were crucial for us to understand both the scientific relevance (stage 2) and the practical applicability (stage 3) of the proposed framework and guidelines. These discussions added value by validating our approach and guidelines as well as confirming their relevance for NBS researchers and practitioners.

3. Results

3.1. Overview of the existing frameworks for NBS realization that relate to inclusivity, justice, equity, and empowerment

Among the 67 reviewed sources proposing various frameworks, strategies, and approaches to guide the planning, governance, and implementation of NBS, we have identified 26 publications that specifically provide frameworks focusing on the aspects of justice and equity, inclusivity, and empowerment in regard to NBS (Fig. 2). Table 1 gives an overview of the reviewed approaches/frameworks and how they consider the forementioned aspects. Although the reviewed sources presented in Table 1 cover the period of 2017–2024, earlier publications also addressed NBS-related aspects of inclusivity, equity, and justice (analysed together), and empowerment. However, our focus has been explicitly on specific conceptual and coherent practical frameworks or approaches, rather than on particular case studies, which are more commonly emphasized in earlier research.

The review of the approaches/frameworks presented in Table 1 has revealed specific **principles** identified for each of the three pillars (see Fig. 3):

- **Inclusivity** is based on the “leaving no one behind” principle, linked to various stakeholder engagement and their equitable contribution to NBS realization,
- **justice and equity*** are applied in regard to the principle of equitable distribution of resources, benefits (ecosystem services), and reduction of burdens (ecosystem disservices) or negative effects;

Table 1

Detailed overview of the approaches/frameworks that consider aspects of inclusivity (I), justice and equity (J&E)*, and empowering governance (EG) for NBS realization, described in the analysed sample.

| Approach/Framework | Goal and focus of the frameworks/approaches | How does it consider inclusivity (I), justice & equity (J&E), and empowering governance (EG) in regard to NBS (mapped pillars) |
|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Mainstreaming approach for implementation of NBS across various governance levels [1] | <ul style="list-style-type: none"> • conceptualizing and facilitating the integration of NBS within urban governance frameworks; • clarifying the concept of mainstreaming NBS for facilitating urban transitions through NBS. | EG: It emphasizes the importance of transformative change, multi-level governance, and knowledge drivers in the adoption of NBS. |
| 2. Principles and steps for NBS planning [8] | <ul style="list-style-type: none"> • structured approach to designing and implementing NBS, including the necessary steps for the planning process; • transdisciplinarity is underlined as a key to create new knowledge and ensure the systematic involvement of diverse knowledge creators and holders in co-design and implementation of NBS. | J&E, I: The planning outputs need to consider aspects of environmental justice, so that NBS can lead to a greener and more sustainable society. Equity is emphasized as a principle of organized participation and the planning outputs. The planning team should organize a socially inclusive planning process, promote transparency, and broad participation. |
| 3. Justice-oriented approach to NBS projects [42] | <ul style="list-style-type: none"> • framework for embedding justice into NBS planning and implementation, ensuring that NBS do not merely green urban spaces but do so in equitable, inclusive, and participatory ways; • integrating dimensions of justice and inclusivity can help to avoid displacement of communities in the areas of NBS realization. | J&E, I: Justice and inclusivity are central themes. Three key justice dimensions are highlighted: 1) distributive justice (benefits and burdens of NBS are equitably shared, also with marginalized and vulnerable communities); 2) procedural justice (inclusive governance, where affected communities are meaningfully involved in decision-making); 3) recognition justice (diverse knowledge systems, identities, and lived experiences in shaping NBS). |
| 4. Guiding criteria for transdisciplinary collaboration in NBS projects [45] | <ul style="list-style-type: none"> • proposing guiding criteria for transdisciplinary collaboration in multidisciplinary and multi-stakeholder projects on NBS realization; • the criteria (e.g. inclusiveness, equity, consistency, and flexibility) act as a monitoring and evaluation strategy for urban NBS design and implementation and stakeholder collaboration. | I, J&E: It emphasizes appropriate inclusion and recognition of diverse values, interests, perspectives; ethical and fair representation of all involved; processes for effective and fair collaboration; involvement of various societal actors in the whole participation process (consultation to knowledge co-production). |

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Table 1 (continued)

| Approach/Framework | Goal and focus of the frameworks/approaches | How does it consider inclusivity (I), justice & equity (J&E), and empowering governance (EG) in regard to NBS (mapped pillars) |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5. Principles for just and equitable NBS [37] | <ul style="list-style-type: none"> principles for ensuring justice and equity in NBS planning, design, and implementation (e.g. considering diverse needs and values of communities, fostering participatory governance, ensuring just distribution of benefits, addressing inequities, long-term & intergenerational visions). | <p>I, J&E, EG: Justice is central to the design and implementation of NBS, inclusivity is linked to the community empowerment through participative governance, equity calls for fair treatment of all stakeholders, corrective justice seeks to redress the historical and systemic imbalances.</p> |
| 6. Framework related to sustainable development and equity in NBS [43] | <ul style="list-style-type: none"> discussing various approaches, e.g. green infrastructure, payments for ecosystem services, biocultural approaches to water management; providing real-world examples and strategies to improve equity and justice outcomes; explaining ways of how NBS can contribute to sustainable development and promote equity. | <p>I, J&E: It explicitly addresses inclusivity and justice in the implementation of NBS and emphasizes the importance of considering distributional, procedural, and recognition equity to ensure that NBS contribute to a more just society rather than exacerbating existing inequities.</p> |
| 7. Assessment framework for climate-proof nature-based solutions [69] | <ul style="list-style-type: none"> framework to evaluate NBS based on four criteria: technical robustness, co-benefits, economic efficiency, and institutional readiness; aimed to support policymakers and planners in selecting and designing NBS that are not only climate-proof but also context-appropriate, cost-effective, and multi-functional. | <p>I, J&E: While justice and inclusivity are not in the primary focus, their relevance is recognized through the criteria of co-benefits and institutional readiness (as enabling conditions for successful NBS). Specifically, it emphasizes the need for 1) distribution of benefits (e.g., access to ecosystem services), 2) importance of engaging diverse stakeholders in planning and implementation, 3) institutional frameworks that support equitable and transparent decision-making.</p> |
| 8. Pathways to increase environmental justice [70] | <ul style="list-style-type: none"> hybrid governance approaches, such as mosaic governance, are examined regarding their contribution to just transformations and sustainable cities through fostering long-term collaborations between local governments, local communities, and grass-roots initiatives. | <p>I, J&E: It proposes six possible pathways to increase environmental justice: greening the neighbourhoods, diversifying values and practices, empowering people, bridging across communities, linking to institutions, and scaling of inclusive discourses and practices.</p> |
| 9. Core principles for successfully implementing and upscaling [10] | <ul style="list-style-type: none"> participatory approaches are emphasized for ensuring that NBS projects are inclusive and reflect the needs of diverse stakeholders, including | <p>I, J&E, EG: Equity can be achieved by ensuring fair distribution of NBS benefits (e.g. climate resilience, ecosystem services, preventing social exclusion). Notes</p> |

Table 1 (continued)

| Approach/Framework | Goal and focus of the frameworks/approaches | How does it consider inclusivity (I), justice & equity (J&E), and empowering governance (EG) in regard to NBS (mapped pillars) |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <ul style="list-style-type: none"> marginalized communities; adaptive management, financial sustainability, and balancing trade-offs help to ensure long-term success and inclusivity in NBS realization. | <p>on justice refer to addressing power imbalances and advocating for policies that support marginalized communities. Equitable governance, co-creation, and shared decision-making to prevent power imbalances in NBS planning are promoted. I, J&E: The framework underlies the value of a participatory approach that is based on involving diverse stakeholders in the development and implementation of NBS. The commitment to inclusivity is quite explicit in the co-production guidance, which sets out principles for co-production, including inclusivity, and supports principles of justice and equity, ensuring that NBS consider various perspectives and needs.</p> |
| 10. Connecting Nature Framework for planning, delivery, and stewardship of urban NBS [29] | <ul style="list-style-type: none"> Integration of social, ecological, and governance aspects into the framework for NBS realization; focus is on planning, delivery, and stewardship processes, but through co-creation and knowledge co-production, it is closely linked to inclusivity; role of participatory approach in facilitating stakeholder engagement and collaboration in NBS. | <p>I, J&E: It emphasizes the need to consider diverse social identities, power dynamics, and equitable participation throughout NBS planning and implementation. This approach ensures that NBS contribute to fair outcomes and do not reinforce existing inequalities.</p> |
| 11. A theoretical gender, inclusion and diversity framework for inclusive NBS in cities [38] | <ul style="list-style-type: none"> six domains of the framework: 1) gender equality; 2) LGBTQI + rights; 3) social, cultural and ethnic background; 4) people with disabilities; 5) integration of refugees and immigrants; and 6) intergenerational perspectives. It is operationalized through a checklist for researchers and practitioners. | <p>I, J&E: The NBS Impact Evaluation Framework embeds social justice and cohesion as a key challenge area. It promotes procedural equity through inclusive participation and co-creation, distributional equity by measuring fair access to NBS benefits across groups, and outcome equity by assessing whether NBS reduce inequalities. It also provides tools to monitor perceptions of fairness and belonging, especially in vulnerable communities.</p> |
| 12. Framework for evaluating the impact of NBS [3] | <ul style="list-style-type: none"> NBS Impact Evaluation Framework as a comprehensive tool for assessing NBS across five key societal challenge areas: climate resilience, natural and built environment, water management, health and well-being, social justice and cohesion; set of quantitative and qualitative indicators tailored to each challenge area (incl. indicators addressing social justice and inclusivity). | <p>I, EG: Among the key principles are engaging multiple stakeholders early and continuously,</p> |
| 13. Lessons learned for integrating NBS into urban planning, governance, and | <ul style="list-style-type: none"> principles for planning NBS in cities; emphasizes the importance of aligning | |

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Table 1 (continued)

| Approach/Framework | Goal and focus of the frameworks/approaches | How does it consider inclusivity (I), justice & equity (J&E), and empowering governance (EG) in regard to NBS (mapped pillars) |
|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| decision-making processes [32] | urban governance structures, planning, and decision-making processes with NBS principles to achieve environmental sustainability and resilience. | incorporating multiple scales of governance; focus on co-creation; leveraging the diversity of knowledge; integrating social and environmental goals. |
| 14. Knowledge Brief produced by NetworkNature on inclusive approach to NBS implementation [36] | <ul style="list-style-type: none"> overview of the inclusion concept in regard to NBS, including its relevance to the EU and international policy, and just sustainability transition; role of inclusive NBS in promoting social and environmental sustainability; best practices, key elements, and tools for improving NBS realization towards more inclusive, equitable, and just approaches. | <p>I, J&E: To address green gentrification, social exclusion, the brief advocates for the active engagement of diverse stakeholders, especially marginalized groups, throughout all stages of the NBS process. This aims to ensure equal access, participation (equitable involvement, clear roles, and power-sharing among all stakeholders), and benefits for all, thereby promoting social and environmental sustainability.</p> <p>I, J&E, EG: Local knowledge and integration of cultural context in terms of inclusive design considering all dimensions of socio-environmental justice are important for NBS design (distributive, procedural, interactional or recognition justice). Polycentric governance and inclusive approach to design and planning of NBS (multiple stakeholder involvement, co-creation) are promoted.</p> |
| 15. Principles for urban NBS planning and governance [12] | <ul style="list-style-type: none"> five distinct, integrated principles for urban NBS design, planning and implementation in urban areas: 1) systemic understanding, 2) benefit for both people and biodiversity, 3) inclusive solutions for the long-term, 4) context conditions and 5) fostering communication and learning; the principles help address governance gaps and contribute to making cities more sustainable. | <p>I, J&E, EG: Local knowledge and integration of cultural context in terms of inclusive design considering all dimensions of socio-environmental justice are important for NBS design (distributive, procedural, interactional or recognition justice). Polycentric governance and inclusive approach to design and planning of NBS (multiple stakeholder involvement, co-creation) are promoted.</p> <p>I, EG: Need for cultural-structural change based on new and inclusive understandings of human-nature relations, and novel governance paradigms that allow cross-sectoral collaboration, coordination, and engagement of local stakeholders beyond formal organisational structures.</p> |
| 16. Inclusive, integrated and long-sighted approach to support transformations [71] | <ul style="list-style-type: none"> role of an inclusive, integrated, and long-sighted approach in supporting transformations needed to endure major contemporary challenges; potential of a more incisive form of Nature-Based Thinking | <p>I, EG: Need for cultural-structural change based on new and inclusive understandings of human-nature relations, and novel governance paradigms that allow cross-sectoral collaboration, coordination, and engagement of local stakeholders beyond formal organisational structures.</p> |
| 17. Framework for planning and assessment of NBS for funders, researchers, policy-makers, and practitioners [72] | <ul style="list-style-type: none"> a framework aiding implementation of NBS, consists of 5 key steps: 1) dealing with uncertainty and complexity (adaptive management approach), 2) ensuring the involvement of multiple stakeholders, 3) ensuring the sound use of multi- and | <p>I, J&E: Inclusivity in the development and implementation of NBS is promoted by arguing that for NBS to effectively contribute to all dimensions of sustainability, it is essential to incorporate the experiences and knowledge of all relevant</p> |

Table 1 (continued)

| Approach/Framework | Goal and focus of the frameworks/approaches | How does it consider inclusivity (I), justice & equity (J&E), and empowering governance (EG) in regard to NBS (mapped pillars) |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | transdisciplinary knowledge, 4) developing common understanding of multifunctional solutions, trade-offs and natural adaptation, 5) evaluating and monitoring for mutual learning. | stakeholders. This inclusive approach ensures that the solutions are comprehensive and equitable. It calls for broad stakeholder involvement that implies commitment to equitable and fair decision-making. |
| 18. Framework to assess ecological injustice hotspots for targeted urban design and planning of NBS [73] | <ul style="list-style-type: none"> a framework for identifying ecological injustice hotspots to guide the NBS design aimed at creating more equitable urban areas (just cities); explaining how to integrate the needs and potential of nonhuman nature into urban transformations, fostering multi- and interspecies relationships that restore social-ecological system; techniques for identifying areas of ecological injustice and specific urban design and planning approaches for implementing NBS there. | <p>I, J&E: It emphasizes fair access to green infrastructure, prevents green gentrification, and promotes participatory planning by involving local communities in decision-making. Additionally, it advocates for recognition and procedural justice, ensuring historically excluded groups have a voice in urban NBS initiatives.</p> |
| 19. Framework for assessing and implementing the co-benefits of NBS in urban areas [34] | <ul style="list-style-type: none"> a framework for assessing and implementing NBS in urban environments, focusing on their multiple co-benefits; it argues that to be effective, NBS must be integrated into urban planning through participatory and cross-sectoral approaches; guide for policymakers, planners, and practitioners in evaluating NBS across ecological, social, and economic dimensions. | <p>I, J&E, EG: Justice and inclusivity are essential for successful implementation of NBS. It highlights the importance of: a) inclusive governance (engaging diverse stakeholders, incl. marginalized/vulnerable groups, in planning and decision-making); b) equitable distribution of benefits (ensuring that all gain access to the advantages of NBS); c) social justice (recognizing and addressing potential inequalities in who bears the costs and who gains the benefits of urban greening, environmental improvements, etc.)</p> |
| 20. Governance framework for NBS in cities, focused on the intersection of justice and equity [39] | <ul style="list-style-type: none"> a structured approach and a governance framework for implementing NBS; integrating the principles of justice and inclusivity into NBS design and decision-making processes are essential to ensure fair distribution of benefits | <p>I, J&E, EG: Ensuring justice and equity in NBS governance helps to address power dynamics, access to green spaces, and participatory decision-making. NBS implementation should prioritize vulnerable communities, prevent environmental injustices,</p> |

(continued on next page)

Table 1 (continued)

| Approach/Framework | Goal and focus of the frameworks/approaches | How does it consider inclusivity (I), justice & equity (J&E), and empowering governance (EG) in regard to NBS (mapped pillars) |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21. Evaluation framework for NBS projects based on the application of performance questions and indicator approach [74] | <p>and address needs of marginalized communities;</p> <ul style="list-style-type: none"> • inclusive governance structures, stakeholder engagement, and consideration of environmental and social justice in NBS projects are emphasized. • an evaluation framework for assessing NBS projects based on a set of performance questions and indicators to be applied systematically across different NBS contexts; • the aim is to provide a comprehensive, standardized approach to evaluate the ecological, social, and economic impacts of NBS so they can support learning, accountability, and better project design; • it is applicable for both planning and post-implementation evaluation phases. | <p>and promote co-production of solutions with local stakeholders. Specific institutional mechanisms are needed to safeguard long-term inclusivity and fairness in urban greening efforts.</p> <p>I, J&E: It incorporates inclusivity-related metrics, supporting fairer and more socially responsive NBS assessments. Justice and inclusivity can be assessed through several social performance indicators: 1) stakeholder participation (importance of inclusive, participatory processes in NBS planning and implementation); 2) social cohesion and well-being (measuring how NBS contribute to community resilience, inclusiveness, and quality of life); 3) accessibility and equity (ensuring that NBS benefits are equitably distributed among society).</p> |
| 22. Framework for managing and scaling urban NBS such as community gardens [75] | <ul style="list-style-type: none"> • NBS as “multifunctional green interventions delivering upon the social, economic and environmental pillars of sustainable development.” • key success factors for NBS: clear objectives and regulations, municipal support, financial resources, social capital, presence of local champions and facilitators fostering community engagement; • a strategic, inclusive approach to design, implementation, and management of urban NBS allows ensuring that NBS are not only sustainable but also scalable to benefit a larger urban society. | <p>I, J&E, EG: Participatory governance and community empowerment are essential for NBS (e.g. urban gardens where diverse stakeholders are involved in decision-making to ensure fair access to urban green spaces). Co-creation and shared management are important for fostering a sense of ownership and social cohesion among community members. It also addresses equitable resource distribution, advocates for policies that prevent the exclusion of vulnerable populations and promotes environmental justice in urban planning.</p> |
| 23. Framework integrating environmental justice measures in governance assessment [76] | <ul style="list-style-type: none"> • importance of a broader framing of governance in NBS assessment frameworks; • role of government-led laws, policies, and regulations, along with community-led and collaborative multi- | <p>I, J&E, EG: The proposed framework and tool encompass nine governance dimensions that facilitate a nuanced understanding of governance aspects, including those related to justice and inclusivity in</p> |

Table 1 (continued)

| Approach/Framework | Goal and focus of the frameworks/approaches | How does it consider inclusivity (I), justice & equity (J&E), and empowering governance (EG) in regard to NBS (mapped pillars) |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24. Framework for assessing benefits of implemented NBS [77] | <p>stakeholder initiatives (inclusivity principle), incl. marginalised communities and environmental justice;</p> <ul style="list-style-type: none"> • proposed governance assessment framework and tool designed for urban decision-makers and stakeholders, enabling the assessment of justice, equity, and inclusivity in NBS projects. • a framework for assessing the realized benefits of implemented NBS, especially in regard to flood risk management and urban resilience; • it considers various benefit categories (e.g. social, environmental, economic, technical), using both quantitative and qualitative indicators; • is designed to help stakeholders, including urban planners, engineers, and policy-makers, monitor, compare, and improve the effectiveness of NBS. | <p>regard to NBS. It focuses on strengthening the consideration of marginalized communities and environmental justice in NBS governance to address disparities and ensure that NBS projects do not disproportionately benefit or burden specific groups, promoting fairness and equity in urban sustainability efforts.</p> <p>I, J&E: It incorporates the following inclusivity-related aspects within the social benefits dimension of the framework: 1) community engagement (evaluating how local stakeholders are involved in the planning and implementation process); 2) social resilience and cohesion (assessing how NBS support vulnerable communities and improve social well-being); 3) equity of access (recognizing the importance of fair benefit distribution).</p> |
| 25. Framework for understanding justice in sustainability pathways and in NBS application [40] | <ul style="list-style-type: none"> • helps to understand justice in sustainability pathways and NBS application by focusing on different dimensions of justice (distributive, procedural, and recognition); • an approach to address environmental outcomes while considering social fairness, inclusion, and the equitable distribution of benefits that contribute to sustainable and equitable urban futures; • critical reflection on the impacts of NBS on different communities, particularly marginalized groups. | <p>I, J&E: It addresses distributive justice (fair distribution of benefits and burdens), procedural justice (ensuring inclusive participation in decision-making), and recognition justice (acknowledging the needs and rights of marginalized communities). By highlighting the complexities and dilemmas of translating these justice concepts into practice, it emphasizes the need for NBS to be designed and implemented in ways that prioritize equity, ensure inclusivity, and address historical and social injustices.</p> |
| 26. Framework for gender and inclusion in NBS [78] | <ul style="list-style-type: none"> • embeds gender equality and social inclusion within NBS projects; • emphasizes the importance of inclusive disaster risk management, advocating for the active participation of | <p>I, J&E: It provides a four-step approach to integrate gender inclusion, ensuring that NBS initiatives are equitable and beneficial to all societal segments. It proposes guidance with practical entry</p> |

(continued on next page)

Table 1 (continued)

| Approach/Framework | Goal and focus of the frameworks/approaches | How does it consider inclusivity (I), justice & equity (J&E), and empowering governance (EG) in regard to NBS (mapped pillars) |
|--------------------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| | marginalized groups throughout all stages of NBS interventions. | points for incorporating gender and social inclusion across various NBS contexts (urban, coastal, etc.). |

- empowering/participatory governance is enabled through the principle of inclusive multi-level governance and broader empowerment via capacity- and ownership building, and better access to resources.
- * We group justice and equity under a single pillar because, while analytically distinct, they are closely interrelated and jointly address fairness in the context of NBS. Equity primarily concerns the fair distribution of benefits and opportunities as well as burden reduction, taking into account different needs and vulnerabilities, whereas justice focuses on fair processes, recognition, and the structural conditions that shape participation and access. Our review shows that existing approaches frequently address these dimensions together and treat them as mutually reinforcing rather than independent. Grouping them under one pillar therefore reflects prevailing practice in the literature while preserving their conceptual distinction within the pillar.

While existing frameworks/approaches provide important conceptual and methodological contributions, significant operational gaps

remain. First, such efforts are rather sporadic and lack the comprehensive strategies that simultaneously address the aspects of inclusivity, justice, equity, and empowerment in regard to NBS and sustainability transition. A few approaches [10,12,34,37,76] touch on all three aspects/principles, but they generally lack a systematic and practitioner-oriented structure/guidelines, limiting their real-world applicability.

Our proposed framework advances the field by explicitly bridging these gaps. It offers a **comprehensive, principle-based, and operationally structured approach** that embeds inclusivity, equity, justice, and empowerment across the entire NBS process. Built on these pillars, the framework translates **abstract theoretical principles** and **criteria** into **actionable guidelines** designed to support researchers, practitioners, and communities in advancing sustainability transition (Fig. 3). The **pillars** represent the overarching normative dimensions (foundational elements) guiding inclusive and just NBS, whereas the **principles** function as enabling specific conditions that operationalize these pillars in practice. To enhance practical applicability, Table 2 (and its extended version A2 in Annex) explains how these principles within particular thematic areas are embedded into a set of actions/measures to achieve and monitor sustainability outcomes, and to make appropriate adjustments/adaptive steps.

We critically reflect on the principles in the next subsections, focusing on engaging all relevant stakeholders (Subsection 3.2), ensuring equitable benefit distribution and burden reduction within communities (Subsection 3.3), and promoting inclusive, transparent, and empowering multi-level governance (Subsection 3.4). Further, we explain interlinkages between inclusive NBS, equity, and just sustainability transition (Section 3.5), provide the guidelines for practitioners on how the proposed framework can be applied (Sections 3.6), and discussed issues of operationalization, limitations, and directions for

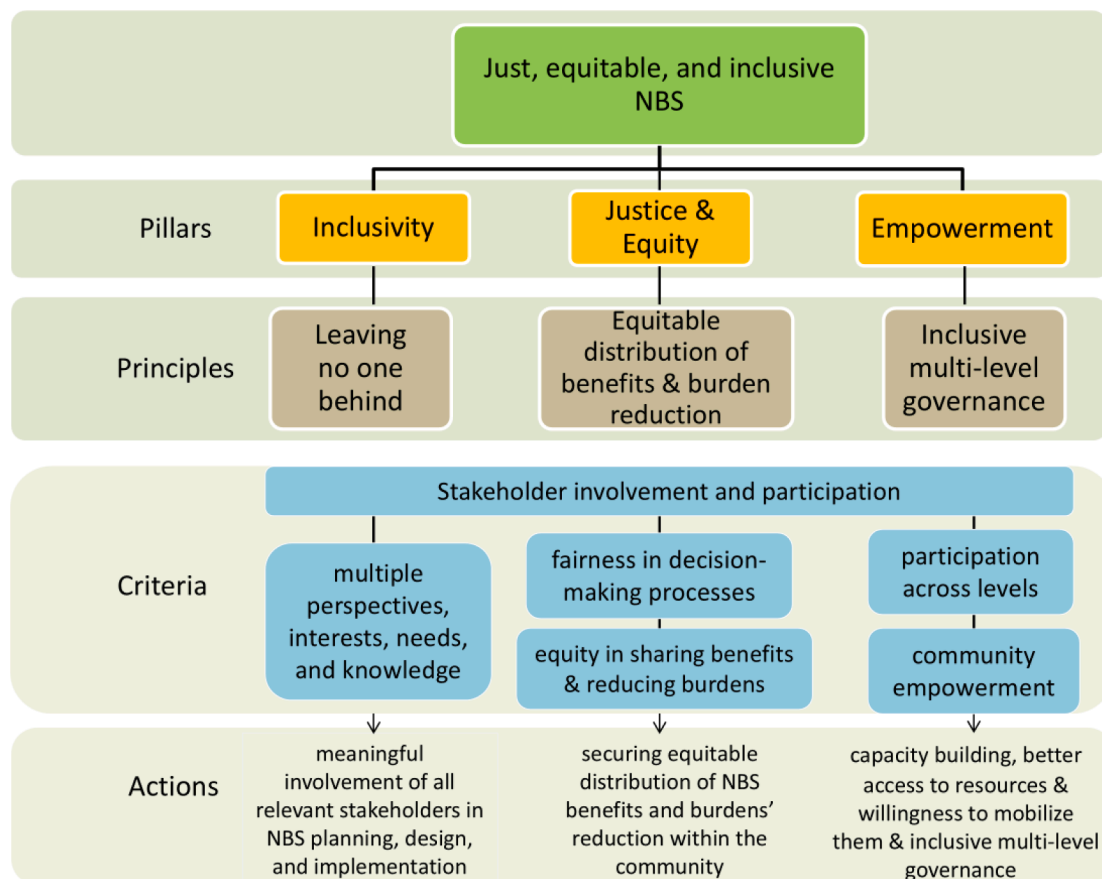


Figure 3. A newly proposed framework for establishing inclusive, just, and equitable NBS based on identified pillars, principles, criteria, and actions.

Table 2

New systematic framework for integrating inclusivity, justice, equity, and empowerment into NBS realization. Abbreviations: I: Inclusivity; J&E: Justice and Equity; EG: Empowering governance.

| Thematic areas | Related pillars | Recommended measures | Monitoring outcomes to track the progress | Adjustments / Adaptive steps |
|----------------------------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Capacity building | Inclusivity, empowering governance | Disseminate NBS knowledge widely; deliver targeted training; integrate sustainability into local education and governance practices (I+EG). Communicate NBS benefits to policymakers, planners, and communities; promote collaboration and joint learning (I+EG). Build local skills and expertise for managing and maintaining NBS (EG). | Communities have access to relevant information; environmental awareness and local expertise increase; collective decision-making capacity improves. Shared understanding of NBS importance achieved; sustained community engagement in design and evaluation. | Expand training programs for underrepresented groups; adapt knowledge-sharing formats to local needs; incorporate feedback into future training cycles. Strengthen communication channels; co-produce outreach materials; include community voices in governance bodies. |
| | | | Communities demonstrate increased capacity to manage NBS projects. | Introduce peer-to-peer learning and mentorship; tailor capacity-building to evolving technical needs. |
| Stakeholder involvement & participation | Inclusivity, justice, empowering governance | Establish inclusive participatory processes and ensure representation of marginalized groups (I+J&E). | Participation is meaningful, empowering, and leads to ownership and stewardship. | Broaden stakeholder base; adjust participation mechanisms to include underrepresented voices; embed co-production in planning. |
| | | Integrate diverse stakeholder perspectives into NBS design and governance (I+J&E). Provide opportunities and platforms for multi-stakeholder collaboration (I+EG). Build trust among actors and address scepticism (EG). | Varied values, knowledge, and perceptions are reflected in decision-making. Co-production processes emerge and reduce conflicts. | Create mechanisms for continuous feedback; revise governance structures to accommodate diverse perspectives. Facilitate long-term partnerships; adapt collaboration formats to new actors and priorities. |
| | | Foster cross-sectoral collaboration and policy integration (I+EG). | Trust indicators increase; community concerns are addressed through adaptation of plans or transparent negotiation | Maintain regular dialogue; use co-monitoring approaches to enhance transparency. |
| Inclusive NBS design | Inclusivity, equity, justice | Ensure equitable access to NBS in design (I+EG+J&E). | NBS is designed to be accessible and usable for all user groups, addresses context-specific vulnerabilities, and promotes justice. Inequities in NBS distribution are reduced. | Revise governance frameworks to institutionalize collaboration; establish joint monitoring committees. Monitor accessibility outcomes and adjust design as needed; adjust design parameters based on social and ecological monitoring |
| | | Implement governance models that address access disparities (I+J&E+EG). Integrate inclusivity into NBS policies (I+EG). Co-design NBS with stakeholders and tailor to local needs (I+EG). | Policies safeguard vulnerable populations and prevent displacement. Solutions reflect local contexts and priorities. | Reassess governance mechanisms and resource allocation. Review policies regularly to address new risks and inequities. Incorporate feedback into iterative design cycles. |
| Benefits, burdens & impacts | Equity, justice, empowering governance | Ensure fair distribution of benefits and co-benefits after implementation (J&E). | NBS benefits are distributed equitably and meet community needs after implementation. | Review benefit-sharing mechanisms and adjust resource allocation. |
| | | Define potential disbenefits and burdens that might arise from NBS as well as vulnerable groups that may be affected (J&E) | Solutions reflect and consider NBS trade-offs/disbenefits, and respective measures are proposed. | Expand interventions addressing disbenefits/burdens. |
| | | Improve public health and living conditions (EG+J&E). Strengthen social cohesion (EG). | Health and well-being indicators improve across social groups. Social integration and shared community spaces increase. | Expand interventions targeting underserved communities. Design future interventions to enhance social interaction. |
| | | Create economic opportunities (J&E+EG). Preserve cultural identity and heritage (J&E+EG). Empower communities and strengthen social networks (EG). | Employment and livelihoods improve, especially for vulnerable groups. Traditional knowledge and cultural values are integrated into NBS. Local agency and shared stewardship increase. | Support emerging green sectors; promote inclusive business models. Deepen partnerships with Indigenous and local communities. Scale co-management models and devolve decision-making authority. |

future research (Section 4.1).

3.2. Principle 1: Leaving no one behind – meaningful engagement of all relevant stakeholders in NBS planning, design, and implementation

The principle of *leaving no one behind* is central to the 2030 Agenda for Sustainable Development [79], the EU's Just Transition strategy (EC Just Transition Mechanism), and the European Green Deal [18]. These initiatives aim to tackle poverty in all its forms, including those rooted in discrimination, exclusion, and inequality [80]. They also provide assistance (incl. financial support) to address the social, economic, and employment-related challenges faced by the regions, ensuring a fair and inclusive transition that leaves no one behind. Aligned with this vision, NBS, as a sustainability approach, embraces inclusivity as a fundamental

principle in its design and implementation, thus ensuring that societal challenges are addressed equitably and that the NBS benefits and burdens are distributed fairly across diverse populations. However, certain groups, such as women, elderly people, people with special needs/disabilities, migrants, and low-income households, may encounter challenges in accessing these benefits [38]. For example, concerns about safety and gender-based violence may prevent women and girls from using such NBS as urban parks, forests, and other green spaces for recreation [36]. Another justice-related issue is the inequitable access to certain NBS (i.e., green spaces) among individuals with lower socio-economic status, as such amenities are typically less prevalent and less accessible in low-income neighbourhoods [12,28,81]. These issues are further compounded when multiple socio-economic aspects intersect. For example, for women with mobility limitations or young,

unemployed people from marginalized communities, the barriers to accessing green spaces and the risks of exclusion can expand [28,36,38,82]. Thus, the 'leave no one behind' principle needs to be incorporated by including diverse voices in NBS planning decisions to ensure all potential challenges are identified, and that multiple perspectives for addressing them are integrated.

Furthermore, the participation of local and Indigenous Communities is critical to the success of NBS initiatives [8,11,13,38,82,83]. These communities often have strong cultural, spiritual, and economic ties to nature, frequently mentioned in the literature as place attachment and sense of place [84]. By integrating Indigenous and local knowledge with scientific research and technologies, NBS can empower these communities and support their sustainability transition. Several studies underline that it is also crucial to consider the needs of vulnerable populations (e.g., women, migrants, people with disabilities) to avoid or mitigate potential negative impacts from NBS projects. During the literature review, several frameworks/approaches to NBS realization have been identified (e.g., [3,8,10,12,32,37,72]). They propose core fundamentals for planning, designing, implementing, and evaluating NBS, with a particular focus on inclusivity. Specifically, *Albert et al.* [8] emphasize equity as a principle regarding both organized participation of multiple stakeholders and a socially inclusive planning process to reinforce transparency and broad participation. Moreover, *Basta et al.* [45] promote equity in relation to equal opportunities for all stakeholders involved to voice their opinions, interests, needs, and objectives. It underlines the need for genuine and appropriate inclusion and consideration of diverse values and perspectives, as well as for extending the formats of participation from consultation to knowledge co-production. Similarly, *Boylard et al.* [37] propose to link inclusivity to community empowerment through different forms of participation (including governance), equity calls for fair treatment of all stakeholders, and more precise consideration of their diverse needs and values. For planning, delivery, and stewardship of urban NBS, *Collier et al.* [29] developed a participatory approach that contributes to aspects of inclusivity by facilitating engagement of various stakeholder and knowledge co-production in NBS projects. The framework implicitly supports principles of justice and equity, ensuring that multiple perspectives and needs are considered in NBS realization. *Cohen-Shacham et al.* [10] offer core principles for NBS, which include social equity and inclusivity as essential criteria for successful implementation, recognizing the need for broader stakeholder involvement. *Nesshöver et al.* [72], *Raymond et al.* [34], and *van der Jagt et al.* [75] also define inclusive participatory processes that incorporate the experiences and knowledge of all relevant stakeholders and foster community engagement as key success factors for NBS realization. Along with them, *Kabisch et al.* [12] stress that planning urban NBS should be grounded in local knowledge and cultural understanding, advocating for collaborative design processes where different stakeholders work together to create NBS that truly reflect the needs and priorities of local communities. The approaches have been advanced by the framework of *Delbaere et al.* [38] that integrates gender, inclusion, and diversity, and highlights how intersecting social factors influence access to NBS benefits, calling for inclusive planning processes. The Knowledge Brief of *Gionfra et al.* [36] and the Factsheet of *EC (2023)* emphasize mainstreaming social justice and equity as well as advocate for the active engagement of diverse stakeholders, especially marginalized groups, throughout all stages of the NBS process. Both publications underline the need for clear role distribution and power-sharing among all stakeholders involved. The Factsheet of *EC (2023)* also provides tools to monitor perceptions of fairness and belonging, especially in vulnerable communities. When NBS are formulated with such inclusive, capacity-building strategies and project design features, they can play a transformative role in addressing social justice challenges in addition to providing immediate climate and environmental benefits, as highlighted by the *World Bank's report* [78]. The report provides a structured approach to integrating gender equity and social inclusion into NBS initiatives across various contexts and

helps to ensure that NBS are not only environmentally effective but also socially just (e.g., through proposing inclusive governance mechanisms).

3.3. Principle 2: Securing equitable distribution of NBS benefits and reducing burdens within the community

The majority of the reviewed frameworks and approaches (Table 1) emphasize the need for justice and equity in the early design and implementation phase of NBS, ensuring fair distribution of direct benefits and co-benefits across all groups of society, particularly marginalized and vulnerable communities [10,29,37,38,36,40,43,73,75]. However, it is important to acknowledge that NBS can generate not only benefits but also disbenefits (occasionally called ecological, social, or economic trade-offs) such as uneven exposure to maintenance burdens, restrictions on land use, ecological risks, or unintended social and economic pressures, increasing conflicts over natural resources, exacerbating food insecurity, reinforcing power imbalances, green gentrification, maladaptation and displacement [10,85,36,86,78,87,88]. This makes the equitable distribution of benefits and reducing disadvantages a core concern of justice-oriented planning. Specifically, *Boylard et al.* [37] advocate for five guiding principles for just and equitable NBS and emphasize that NBS design should consider disadvantaged groups, ensuring no one is left behind. *Bremer et al.* [43] recommend assessing the fairness of benefit allocation as a core equity concern in regard to NBS. In particular, they suggest exploring equity through three key lenses: distributional (who benefits?), procedural (who participates?), and recognition (whose knowledge matters?), to prevent reinforcing existing inequalities. Moreover, distributional equity requires explicit consideration of the uneven allocation of costs or burdens, such as increased flooding risks when water is redirected, displacement pressures from green gentrification, or long-term maintenance responsibilities/costs that may fall disproportionately on resource-poor communities.

Similarly, *Toxopeus et al.* [89] and *Wijsman and Berbés-Blázquez* [40] focus on distributional, procedural, and recognition aspects of justice within the context of NBS and underline that diverse voices are not only heard but can also influence outcomes. In their core principles for successful NBS, *Cohen-Shacham et al.* [10] include equitable sharing of NBS benefits as one of the key criteria and explicitly state that NBS must be designed and implemented to ensure benefits are accessible to all social groups, especially the vulnerable ones. *Frantzeskaki* [32] also mentioned the principles of co-creation, leveraging diverse forms of knowledge, and integrating both social and environmental goals as central to ensuring that NBS are beneficial to all. The NBS Impact Evaluation Framework/Handbook for practitioners [3] embeds social justice and cohesion as a key challenge area. The Handbook promotes procedural equity through inclusive participation and co-creation, distributional equity by measuring fair access to NBS benefits across social groups, and outcome equity by assessing to what extent NBS reduce inequalities. Along with this Handbook, other frameworks [45,6,72,34,74,77] also propose specific criteria for monitoring and evaluation of NBS performance/impact that incorporate inclusivity and justice-related aspects. Among them are the criteria that help to assess how NBS improve social well-being and resilience and how fairly various NBS benefits are distributed. *Collier et al.* [29] translate inclusion and justice into operational tools that assist practitioners identify and balance co-benefits across various social groups, making equitable distribution also linked to multi-level governance. Their work bridges the gap between equity goals and practical planning tools. *Delbaere et al.* [38] demonstrate how gender and socio-economic variables (e.g., age, ethnicity, and income) jointly influence the NBS accessibility and benefit delivery. Their work helps to ensure that various domains of equity are considered in NBS design by suggesting a specific checklist for researchers and practitioners. The Factsheet of *EC (2023)* promotes different types of equity: a) procedural equity through inclusive participation and co-creation, b)

distributional equity by measuring fair access to NBS benefits across groups, and c) outcome equity through assessing how NBS contribute to reducing inequalities. *Gionfra et al.* [36] highlight the need for EU policies to integrate equity in the distribution of NBS benefits, underlining the essential role of governance structures that should monitor and ensure fair allocation of environmental and social benefits across different demographic and spatial groups. *Pineda Pinto et al.* [73] focus on climate justice and emphasize the planning dimensions of NBS that allow the redistribution of NBS benefits to historically underserved neighbourhoods. *van der Jagt et al.* [75,76] stress the importance of community involvement in the early stages of the NBS process, as this can increase the likelihood that NBS benefits align with local needs and are distributed fairly among residents.

Taken together, this second principle of “equitable benefit distribution and burden reduction” underscores that embedding equity and justice at the core of NBS design and implementation is essential for social legitimacy and effectiveness. Moreover, it ensures that NBS actively contribute to redressing systemic inequalities rather than reinforcing them. Attention to the distribution of disbenefits is therefore equally crucial: equitable NBS must avoid concentrating risks, responsibilities, or unintended harms on socially disadvantaged community groups.

3.4. Principle 3: Fostering community empowerment through inclusive multi-level governance and other actions

Recognizing the existing inclusion challenges and their significance for the successful implementation of NBS and broader sustainability efforts, the IUCN Global Standard for NBS ([11], pp. III-IV) has developed eight criteria: 1) NBS effectively address societal challenges; 2) design of NBS is informed by landscape scale; 3) net gain to biodiversity and ecosystem integrity are ensured; 4) NBS are economically viable; 5) inclusive, transparent, and empowering governance processes are promoted; 6) NBS equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits; 7) NBS are managed adaptively based on evidence; and 8) NBS are sustainable and mainstreamed within an appropriate jurisdictional context. In particular, criterion 5 emphasizes the role of inclusive governance and points out that the concerns of a wide range of stakeholders have to be acknowledged and considered. Additionally, criterion 6 related to balanced trade-offs stresses the importance of identification and documentation of the potential costs, benefits, and trade-offs throughout the entire NBS life cycle.

Multi-level governance recognizes that NBS adoption is not confined to a single level of decision-making but requires coordination and action across local, regional, and national spheres. This is underlined in the mainstreaming approach for NBS implementation by *Adams et al.* [1]. Furthermore, this approach emphasizes the critical role of knowledge drivers (e.g., scientific research, local expertise, and community-based knowledge) in fostering the effective NBS realization. Similarly, the *World Bank's* [78] report also highlights the importance and clear connection between multi-level governance and the successful deployment of NBS, which requires coordination across various levels of governance.

In the lessons learned from integrating NBS into urban planning, governance, and decision-making processes, *Frantzeskaki* [57] advocates for early and continuous engagement with multiple stakeholders, as well as the need to incorporate multi-governance scales for a more robust and equitable approach to developing urban green infrastructure. The principles for urban NBS planning and governance proposed by *Kabisch et al.* [12] outline the need for integration of local knowledge and cultural contexts into decision-making processes. Moreover, they advocate for polycentric governance, which involves multiple levels of decision-making and the participation of diverse actors in the design and implementation of NBS. The importance of polycentric governance is also emphasized by the research of *Wijsman and Berbés-Blázquez* [40],

which highlights the need for more inclusive governance models based on contributions of municipalities, citizens, and NGOs in NBS realization. *Toxopeus et al.* [89] refer to this governance as multi-actor or hybrid, defining it as a key opportunity for upscaling urban NBS. Their work outlines three main policy implications for hybrid governance settings that address justice issues: 1) the need for transparent decision-making regarding the distribution of costs and benefits; 2) the importance of safeguarding public control over urban NBS; and 3) the integration of scientific expertise with bottom-up consultation processes to ensure the inclusion of both current and future voices.

Other studies [42,39,75,76] propose governance frameworks for NBS that intersect with justice, equity, and empowerment. These frameworks demonstrate the importance of addressing power dynamics and building a sense of ownership through participatory decision-making processes, considering perspectives of vulnerable communities in NBS, and promoting environmental justice and knowledge co-production. The frameworks advocate for institutional mechanisms that ensure long-term inclusivity and equity, safeguarding the needs of disadvantaged populations while promoting equitable access to NBS.

3.5. Interlinkages among inclusive NBS, equity, and just sustainability transition

NBS hold considerable potential to operationalize just *sustainability transitions* in an *inclusive* way. There is growing evidence demonstrating the transformative potential of NBS for creating green jobs and contributing to social *justice* [33] and integrating social and economic dimensions into environmental actions [90]. Current estimates suggest that around 75 million people are already working on NBS, and that tripling investment in NBS by 2030 could create additional 20 million jobs [3,36,90,51]. These employment opportunities can support *equity* and address employment gaps while providing fair wages, improved health and well-being, and greater work stability. Nevertheless, to support transition, specific *justice*-related policies and measures are necessary to mitigate the impact of shifting away from the current unsustainable use of nature. Among them are job placement services, re-employment training, ensuring access to unemployment benefits, and the use of payment for ecosystem services (PES) programmes, as mentioned by the joint report of IUCN, ILO, and UNEP [90]. To respond to this need, practical guidance and policy recommendations for public authorities, decision-makers, private organizations, and other stakeholders have been provided [51] to ensure that NBS contribute not only to environmental sustainability but also to social justice and economic resilience. The recommendations are built around the following aspects: strengthening local employment, promoting gender equality and social inclusion, ensuring just transitions for workers, and fostering multi-stakeholder collaboration. They increasingly highlight how inclusive NBS governance can contribute to just transitions by strengthening local employment, promoting gender equality and social inclusion, ensuring fair outcomes for workers, and fostering multi-stakeholder collaboration [51]. Moreover, inclusive approaches to planning and implementing NBS can shift human–nature relations, embedding sustainability into everyday practices such as resource use and consumption [71].

Inclusivity, justice and equity are closely related concepts and often appear in existing frameworks for planning, designing, and implementing NBS [3,8,10,12,37,32,72]. For example, in regard to urban NBS, social *equity* involves ensuring that lower-income communities have access to parks and other green spaces just like wealthier neighbourhoods do. In relation to the NBS process, *inclusivity* allows creating spaces where all stakeholders feel recognized, respected, valued, and able to participate fully, regardless of their race, gender, socioeconomic status, or other characteristics. However, inclusivity goes beyond just having diversity in stakeholder representation; it is also about ensuring that each stakeholder has a voice and an equal chance to contribute and

succeed (which is closely linked to power and power relations). In this case we deal with promoting both social and environmental *justice*, aiming to develop and implement environmental and social policies that benefit all communities.

Critically, the interlinkages between inclusive NBS and equitable and just sustainability transitions lie in their shared commitment to equity, justice, and empowerment. Social and environmental justice serve as a guiding principle that drives efforts towards both equity and inclusion, ensuring that everyone in the society has the opportunity to contribute to NBS design and implementation, and that the NBS benefits are equally distributed within the community.

3.6. New systematic framework and guidelines for practitioners to support planning and implementing inclusive NBS towards a just sustainability transition

Inclusive implementation of NBS requires a multidimensional approach that ensures equity, participation, and accessibility across all stages – from planning to benefit distribution. Based on the literature review and previous project experiences, we present actionable guidelines with practitioner-oriented instructions that translate abstract themes and pillars into concrete actions and monitoring steps across the NBS lifecycle. Unlike many existing frameworks and approaches, which are fragmented, highly conceptual, or cover only parts of the inclusivity–equity–empowerment relationships, our guidelines provide a coherent, pillar-based structure aligned with NBS planning, implementation, and evaluation. They offer actionable measures, adaptive steps, and monitoring outcomes that help practitioners apply these pillars in real-world contexts and track the progress. This makes the guidelines more operational and user-friendly than most current NBS frameworks, which often lack clear stepwise guidance for implementation and assessment. For this purpose, the main principles and criteria for inclusive NBS are summarised, addressing both socio-economic and environmental challenges while supporting just sustainability transition (see Fig. 3). They were translated into specific, mutually non-exclusive thematic areas: 1) capacity building, 2) stakeholder involvement and participation, 3) inclusive NBS design, and 4) benefits provided (Table 2, guidelines). To support practitioners on how more effectively integrate those principles and criteria into the NBS realization process, these four thematic areas have been supplemented with guiding questions, specific actions/requirements, and adjustments/next steps (Table 2 below and Table 2A in Annex). Notably, not all of these thematic areas and questions will be considered equally in the NBS realization; per case, relevance might differ. For example, the provision of economic opportunities might be more relevant to a large-scale green space development whereas it is less applicable to pocket parks or community gardens, even though both embody the idea of empowerment and inclusivity. Similarly, not every NBS may seek or achieve cross-sectoral collaboration; nevertheless, the realization process may still result in an inclusive NBS due to strong leadership.

Table 2 and its extended version Table 2A (in Annex) are based on two types of literature sources: 1) references in bold and italics (Table 2A in Annex) represent the core frameworks reviewed (see Table 1); and 2) additional references, including grey literature, to supplement the reviewed frameworks and fully capture all relevant criteria and requirements. By combining and structuring the existing frameworks and other publications on inclusive NBS for just sustainability transitions, we were able to distil the core aspects of inclusivity and justice, and cluster them into specific thematic areas. As a result, we developed a new comprehensive and systematic framework (Table 2) and the guidelines. Table 2 introduces thematic areas to clarify the operational structure of our framework and to bridge three conceptual pillars (justice, equity and inclusivity, and empowerment) with practical actions (recommended measures) and monitoring outcomes to track the progress. While the pillars represent overarching principles, they are abstract and not directly actionable on their own. Thus, the added value of the newly

proposed systematic framework serves several purposes:

- 1) operational translation of pillars (they break down broad principles into manageable, action-oriented domains that guide implementation; e.g., capacity building translates the empowerment pillar into specific actions communities can take or receive);
- 2) structured organization of actions and outcomes (by defining thematic areas, we can systematically link each measure to relevant pillars and to potential monitoring outcomes, ensuring that the framework is both comprehensive and measurable);
- 3) facilitate monitoring and adaptive management (thematic areas provide a logical structure for tracking progress, identifying gaps, and making iterative adjustments; they act as bridges between high-level principles and concrete, context-specific interventions).

The objectives of the guidelines within each thematic area are intended to guide NBS scientists and practitioners on a) how each NBS intervention can be designed and implemented to ensure that benefits are equitably distributed while minimizing potential disbenefits or burdens for vulnerable and marginalized groups, and b) which mechanisms and adaptive steps are necessary to continuously monitor and adjust NBS actions to enhance inclusivity, justice, equity, and empowerment across diverse communities.

Below, we provide the guidelines for NBS scientists and practitioners, reflecting on each of the four thematic areas and their relation to the specific pillars (see Table 2). For each area, we summarize the corresponding *recommendations* (based on *measures* to achieve the objective), and outline key *monitoring outcomes* to evaluate progress. The applicability of each measure and the associated monitoring outcome may vary depending on the type of NBS and the local context. Practitioners should adapt actions (*adaptive steps*) and tailor indicators to the specific characteristics, scale, and objectives of the NBS being implemented.

Thematic area 1: Capacity building

Objective: to ensure that communities are empowered to make informed decisions, access information/relevant knowledge, and develop the expertise necessary to sustain and manage NBS initiatives.

Monitoring outcomes: equal information access, knowledge sharing, skill development.

Overall recommendations: A fundamental aspect of inclusive NBS lies in building the necessary capacities within communities. This involves not only disseminating information widely but also ensuring that all community members, regardless of their background, have equal access to knowledge and decision-making processes [38,36,78]. As review results show, raising environmental awareness and fostering local expertise enhance a community ability to manage natural resources, respond to environmental challenges, and contribute meaningfully to sustainability goals [48,32,91]. Effective capacity-building efforts also emphasize inclusive form of nature-based thinking [71]; collaborative learning and co-production of knowledge, ensuring that citizens are not passive recipients but active agents in shaping NBS [73,92]. By inclusive forms of nature-based thinking, we refer to approaches that integrate diverse knowledge systems, values, and lived experiences into how NBS are understood, planned, and managed. This includes incorporating local, Indigenous, and community knowledge; ensuring that different social groups can meaningfully contribute to defining NBS priorities, and promoting shared learning processes that reflect multiple ways of relating to nature.

Thematic area 2: Stakeholder involvement and participation

Objective: to evaluate the degree of inclusivity and representation of various stakeholder groups (including marginalized, intergenerational population, and people with special needs/disabilities).

Monitoring outcomes: stakeholder diversity, recognition of perspectives and knowledge systems, trust-building, and multi-/cross-sector collaboration.

Overall recommendations: Inclusivity requires the meaningful representation of diverse groups of stakeholders, including marginalized

populations such as refugees, people with disabilities, and representatives of various generations [37,38,49,70,93]. Participation should be empowering [10,17,45], facilitating learning, building legitimacy, and generating social innovations and socially inclusive NBS models [85,94]. Multiple stakeholder perspectives, including local knowledge, cultural values, and environmental norms, should be recognized and integrated into NBS planning and evaluation to ensure inclusive and context-sensitive outcomes [10]. This pluralistic approach fosters dynamic, interactive, and iterative relationships between people and nature, in which diverse stakeholders co-produce knowledge and jointly make decisions, thereby supporting governance models that are polycentric (with multiple centres of decision-making and shared responsibilities), transparent, and inclusive [76,85,94]. Additionally, mechanisms to build trust among actors, create ownership, and support collaboration across sectors and institutional boundaries should be developed and put into practice [32,95].

Thematic area 3: Inclusive NBS design

Objective: to ensure that NBS are inclusively designed, context-specific, and equitably accessible to all, especially vulnerable, marginalized, and minority groups.

Monitoring outcomes: equitable access to NBS for all target users, inclusive governance and participatory planning, context-specific and locally tailored NBS design.

Overall recommendations: Inclusive design is a fundamental component of just and sustainable NBS as it ensures that their use and benefits provided are accessible/available to as many people as reasonably possible, accounting for physical, social, and cultural accessibility [12,81,83,82,96]. To achieve this, NBS governance should integrate aspects of justice and inclusivity [76] by actively redressing systemic inequalities, challenging dominant paradigms of nature production and access, and recognizing the rights and needs of marginalized and vulnerable groups [36,63,70,91]. Furthermore, inclusive NBS planning requires that diverse communities, notably minorities or low-income residents, are protected from negative outcomes like green gentrification or displacement [28,88,93,97]. This includes embedding NBS in policy frameworks that promote social equity while delivering environmental benefits [12,32]. Equally, effective inclusive design involves multi-option planning, where NBS are co-developed with stakeholders through dialogue, participatory scenario-building, and testing, allowing for solutions that reflect local conditions and priorities [13,35,38,55,98]. Importantly, redressing systemic inequalities also requires institutional learning and adaptive governance, as organizational structures and decision-making processes shape NBS implementation and influence vulnerability. Iterative learning, reflexive practices, and organizational adaptation are therefore critical to ensure that inclusive and equitable outcomes are achieved [99]. To ensure that NBS interventions are context-specific and resilient, it is essential to consider aspects such as location, architectural typology, species selection, and microclimate while integrating various values, needs, and knowledge [17,30,100].

Thematic area 4: (Dis)Benefits obtained from NBS

Objective: to assess whether NBS deliver multiple, fairly distributed benefits and burdens across diverse societal groups while supporting community empowerment, economic inclusion, and cultural continuity.

Monitoring outcomes: fair benefit distribution, extending solutions to address disbenefits and burdens, improved quality of life, social cohesion, economic inclusion, and cultural preservation.

Overall recommendations: Inclusive NBS initiatives are expected to generate multiple co-benefits that address social and environmental justice by equitably meeting diverse community needs [10,37,85,82,76]. Such approaches prioritize the fair distribution of NBS benefits across stakeholder groups, particularly in underserved or marginalized areas, but also consider NBS trade-offs/disbenefits and vulnerable groups that can be affected by them (Debele et al., 2017; [13,93]). Design and implementation of NBS should enhance the health and living conditions of all residents, especially those in neglected or formerly excluded districts [31,49]. NBS play a vital role in fostering social

cohesion by creating inclusive spaces for recreation, interaction, and shared experiences [45,101]. These spaces can help strengthen community ties and support inclusive planning practices for a better collective future [63]. Economic inclusion is another essential aspect, with NBS offering employment and livelihood opportunities in green industries such as urban farming, restoration, and eco-tourism [18,36,97,78]. These opportunities are particularly beneficial for integrating marginalized groups and reducing socioeconomic disparities [15,97]. Culturally, NBS that incorporate traditional ecological knowledge and heritage practices support community identity and environmental stewardship [8,19,39,72,82]. These efforts reinforce the social fabric by promoting shared ownership and responsibility for both people and nature [21,81].

4. Discussion

4.1. Critical reflection on applying the newly proposed framework and guidelines for integrating inclusivity, justice, equity, and empowerment in NBS

Although the review revealed a variety of existing approaches to integrating inclusivity, justice, equity, and community empowerment, several gaps remain in operationalizing these aspects in ways that meaningfully address existing power structures, organizational constraints, and conflicting interests [49,38,102]. However, not every intervention is inherently beneficial: sustainable adaptation requires acknowledging local contexts, integrating diverse values, and ensuring that responses do not exacerbate vulnerabilities or inequities. Applying these requirements to NBS highlights the importance of context-sensitive, socially just, and reflexive approaches that align environmental interventions with specific needs and capacities of local communities [99]. These gaps limit the transformative potential of NBS for advancing sustainability transitions and raise questions about whose interests are prioritized in current practices, highlighting the need for in-depth research on their contextual adaptation, long-term impacts, and mechanisms for implementation [37,40,44]. Moreover, our experience, aligned with several studies, underscores the need for iterative learning and institutional reflexivity in NBS governance, ensuring that adaptation measures enhance social justice and avoid unintended negative consequences [99,103]. Thus, it is essential for governments, policymakers, and intergovernmental institutions (e.g., IPBES, the World Bank) to engage with the full range of perspectives and critiques from environmental justice movements. Incorporating these perspectives into scientific assessments, policy guidance, and the funding of sustainable development projects can help guide more effective responses to inequities, address gaps in existing environmental policies, and integrate multispecies and ethical considerations into NBS [102,104]. Environmental justice movements offer critical insights into the spatial distribution of social and environmental benefits and burdens from NBS, highlight systemic inequities, and advocate for the inclusion of disadvantaged communities in decision-making. For example, urban greening initiatives informed by environmental justice can ensure that green spaces are equitably distributed across low-income neighbourhoods, and wetland restoration projects can incorporate the needs and traditional knowledge of local Indigenous Communities.

The framework and guidelines developed in this study represent an important step towards embedding inclusivity, justice, equity, and empowerment across the NBS lifecycle. By consolidating fragmented insights from existing frameworks and approaches (Table 1) and translating abstract principles into actionable criteria, the proposed framework (Table 2 and Table 2A in Annex) and guidelines provide a systematic tool for researchers and practitioners aiming at aligning NBS initiatives with sustainability transitions. Nevertheless, as with any normative framework, its translation into practice is contingent upon socio-political, institutional, and ecological contexts, and requires extended empirical validation, critical assessment, and iterative

refinement. While Section 4.2 focuses on limitations and future research, it critically interrogates the assumptions, gaps, and structural constraints revealed in integrating inclusivity, justice, equity, and empowerment in NBS initiatives.

Evidence shows that without attention to *inclusivity*, participatory processes may reproduce existing power asymmetries, exclude under-represented and marginalized groups from decision-making, and favor the priorities of more privileged stakeholders [6,11,37,38,36,42]. This suggests that inclusivity, when treated as tokenistic participation, risks legitimizing interventions without redistributing decision-making power. Ensuring meaningful stakeholder involvement is therefore essential for equitable access to benefits and recognition of diverse knowledge systems [6,11,38,36]. Translating inclusivity into practice requires more than procedural mechanisms; it demands deliberate attention to context-specific barriers, intersectional vulnerabilities, and proactive mitigation of exclusionary outcomes to prevent reinforcing power asymmetries [42,44–46].

Justice in NBS extends equity by incorporating procedural, recognition, and distributive dimensions into NBS governance [37,39,42]. Critical reflection reveals that many frameworks offer broad principles for justice but often fail to provide concrete guidance for its operationalization across scales, from neighbourhood-level to landscape-scale interventions [11,36,49]. Justice involves consideration of environmental recognition, participatory capabilities, and structural inequalities that shape both access to resources and exposure to environmental risks [102,104]. Furthermore, achieving justice cannot rely solely on stakeholder engagement; it demands explicit focus on power dynamics, institutional accountability, and long-term resource allocation, alongside critical reflection on who benefits and who bears the risks in NBS interventions [13,42,44,52,73,83].

Regarding *equity*, empirical studies emphasize that deliberate mechanisms to address inequities not only ensure the fair distribution of NBS benefits and burdens across social groups but also support meaningful stakeholder participation and recognition of diverse knowledge and values [10,37,38,40,43]. Yet institutional biases and uneven resource allocation can limit these efforts. Equitable benefit-sharing requires not only inclusive design and governance but also monitoring and evaluation mechanisms that explicitly measure and correct for disparities in NBS access, use, and socio-economic outcomes [3,28,29,85,33,88,97]. To this end, the proposed framework outlines specific monitoring outcomes to track the progress systematically, recognizing that evaluation itself is a site of political and social negotiation.

While inclusivity, justice, and equity are essential for guiding the inclusive, fair, and ethical implementation of NBS, they are insufficient without *empowerment* – a critical complementary aspect that enables communities to actively shape governance, co-create solutions through capacity- and ownership building, improve access to resources, and sustain interventions over time [32,47,49,48,75,40]. Critical reflection shows that empowerment is often treated superficially, limited to consultation, and rarely addresses the redistribution of decision-making power necessary for transformative outcomes [49,12]. Studies demonstrate that empowered communities are better able to address trade-offs, negotiate priorities, and foster locally relevant sustainability transitions [48,95,3,36]. The proposed framework provides concrete approaches (including focus areas for evaluation indicators and related actions) to systematically integrate empowerment across NBS project phases, embedding capacity-building, participatory governance, and multi-level decision-making mechanisms.

Integrating inclusivity, justice, equity, and empowerment is particularly significant for linking NBS to sustainability transitions. Inclusive NBS not only provide environmental and social co-benefits but also create pathways for just transitions by generating green jobs, enhancing local livelihoods, and embedding sustainability into everyday practices [3,36,90]. However, realizing this potential also depends on careful consideration of socio-political and economic dimensions, as technical and ecological interventions alone cannot guarantee equitable outcomes

[37,50,39]. In other words, without integrated empowering (multilevel) governance strategies, NBS may improve ecological conditions while structural inequalities remain unaddressed or even exacerbated.

Finally, to make the proposed framework and guidelines more practitioner-oriented, translating justice, equity, and empowerment principles into actionable steps, more specific mechanisms are needed for assessing local vulnerabilities, negotiating trade-offs, monitoring benefit distribution, and fostering ongoing community engagement. By embedding these dimensions systematically, NBS initiatives can serve not only as technocratic ecological solutions but also as instruments for societal transformation, promoting inclusivity, fairness, resilience, and sustainability across multiple scales [13,44,95,102]. In this regard, the suggested framework and guidelines serve as structured, pillar-based heuristic tools that can systematically support (rather than prescribe) reflection, critical adaptation, and contextual translation by practitioners and planners during the complex work of integrating inclusivity and justice into diverse NBS processes.

4.2. Limitations and future research

The semi-systematic review revealed a broad scientific and policy debate on the topic. Yet, comprehensive approaches that consider all aspects of inclusivity and justice, while also offering practical guidance for integrating them into the realization of NBS, are lacking. The study addresses these gaps by developing and proposing such a framework and guidelines.

Nevertheless, reflection on the applicability of the proposed requirements must take into account several limitations. First, the limited number of studies directly addressing the research objective may restrict the robustness and generalizability of the requirements. For this, a full systematic review could help to position this framework within the broader body of literature more precisely, as well as extend and refine the proposed requirements. Second, the scarcity of aggregated data hampers the ability to effectively investigate relationships between NBS and inclusivity, potentially affecting the comprehensiveness of the requirements. Finally, the variability of context-specific aspects/factors across different countries complicates comparative analyses, which may influence the feasibility and adaptability of the proposed requirements in diverse settings.

The proposed framework (with its principles, criteria, and actions) outlines best practices for inclusive and just NBS and supports their real-life application. Although informed by policy discourse, expert input, and authors' experiences, it is largely grounded in theory. As such, it requires further validation through extensive practical application and more comprehensive stakeholder testing across diverse contexts. Future research should prioritize participatory evaluation exercises and case studies that engage local stakeholders to validate and refine these requirements, ensuring their true applicability and impact. Additionally, by focusing on comparing the pathways between NBS and inclusivity across different countries and regions, we can further identify challenges related to scaling up this framework and assessing NBS performance. Furthermore, several of the proposed monitoring elements remain at a relatively conceptual level. A full delineation and operationalization of concepts such as environmental awareness or collective decision-making would exceed the scope of this paper. This level of conceptualization is intentional and reflects the aim of providing a flexible, cross-contextual framework rather than context-specific indicators. A more detailed operationalization of these concepts is a subject of the future research.

Based on our experience in the field, we can state that real-world implementation of NBS often faces significant constraints, particularly at the local policy level. This was also emphasized by other studies [1,95,85,103]. Policies promoting community participation in NBS are frequently non-binding or absent, which limits their impact on actual NBS planning and design [85]. To assess the practical relevance and impact of the proposed principles and criteria, future case studies,

including living labs, could test the framework through participatory processes and evaluation exercises. This will allow for a critical examination of how different policy environments enable or hinder the integration of the mentioned principles into NBS realization.

Another key challenge is that NBS interventions (and blue-green infrastructure) are sometimes planned and implemented opportunistically (e.g., as secondary components of larger infrastructure projects) or as part of a scientific agenda, rather than through strategic, community-driven planning [105,106]. Therefore, it is important to further investigate governance mechanisms and institutional arrangements that foster more intentional, stand-alone NBS implementation [39,82,85,103].

A further possible research direction is to delve deeper into the structural dimensions shaping inclusivity in NBS projects, such as addressing barriers in regard to institutional and governance structures, systemic inequalities and power dynamics, cross-sectoral inclusivity, etc. Understanding these factors is essential for designing NBS interventions that genuinely foster just and sustainable transition [39,83,98].

Finally, a detailed analysis of the practical barriers preventing NBS projects from being inclusive or truly promoting a just sustainability transition was beyond the scope of this research. However, our experience, along with other research (e.g., [1,15,40,56,95,98,103]) shows that such barriers may include limited funding, lack of policy interest in broad community participation combined with a prevailing top-down governance model, lack of stakeholder awareness, and low community engagement due to stakeholder fatigue/resistance. Additionally, community ownership of NBS remains aspirational in many contexts, largely due to legal, administrative, and visibility challenges [22,82]. Often, NBS are hidden from public view or managed without community involvement to avoid complexity and potential conflicts arising from diverse stakeholder interests [8,15,56,46]. Future research should investigate these constraints in depth, considering the complexity of governance processes [107] and propose actionable solutions, particularly in regard to legal and institutional barriers to community ownership, as well as design and governance models that could strengthen shared stewardship.

5. Conclusions

This study offers a comprehensive framework and guidelines to support researchers, policymakers, and practitioners in designing and implementing inclusive NBS towards a just sustainability transition. The framework is grounded in the key pillars – inclusivity, justice, equity, and empowerment, and the associated principles essential for NBS realization: leaving no one behind, ensuring equitable distribution of NBS benefits and burden reduction within the community, and fostering community empowerment through inclusive, multi-level governance. To facilitate the integration of these principles, specific criteria and recommended measures are proposed in the form of guidelines. These guidelines illustrate how embedding the forementioned principles throughout the NBS lifecycle can contribute to long-term structural shifts towards more sustainable systems, address inequalities, redistribute decision-making power, and support capacity building, active participation, and better access to resources. Additionally, the guidelines support monitoring and adaptive management by providing a structured approach for tracking progress, identifying gaps, and making iterative adjustments, while linking high-level principles to concrete, context-specific interventions.

Results from our analysis also highlight that in order to truly drive a just transition (thus realizing their full transformative potential), NBS require careful planning and design with attention to socio-political factors, such as power dynamics, stakeholder participation, and potential barriers to access. This is reflected in limitations, including

variability of context, institutional and governance constraints, opportunistic implementation, and challenges related to sustained funding and community engagement. The developed framework addresses these aspects by ensuring that NBS provide not only environmental and social co-benefits but also equitable, just, and inclusive outcomes. By acknowledging these constraints and embedding mechanisms for participatory evaluation and iterative adaptation, NBS can function as instruments for societal transformation, promoting inclusivity, fairness, resilience, and sustainability across multiple scales.

Data availability

References and links to the literature reviewed in this study are provided in [Tables 1 and 2A/Annex](#) as well as in the list of references.

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CRedit authorship contribution statement

Diana Dushkova: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Olga Ivlieva:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation. **Marie Vandewalle:** Writing – review & editing. **A. Rita Carrasco:** Writing – review & editing, Writing – original draft. **José Pontón-Cevallos:** Writing – review & editing, Writing – original draft. **Ina M. Sieber:** Writing – review & editing, Writing – original draft.

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.

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Annex

Table 2A

Guidelines with specific goals, actions, and supporting literature for ensuring inclusivity, equity, justice, and empowerment throughout the entire process of NBS realization (Note: references include the core approaches and frameworks reviewed (see Table 1); however, additional references, including grey literature, were integrated to supplement these reviewed frameworks and provide more details on criteria and actions).

| Thematic areas | Navigating questions | Recommended measures | References |
|-------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Capacity building | Are the necessary capacities built to make informed decisions? | <ul style="list-style-type: none"> information on NBS is disseminated among the community, each community member has access to information and knowledge (inclusive form of nature-based thinking); environmental awareness is raised, local expertise in sustainability is enhanced; community can manage local resources sustainably, make decisions collectively, and adapt to challenges effectively. | [13,20,36,38,48,66,71,73,78,91,92] |
| | Are informing of and collaboration with communities taking place? | <ul style="list-style-type: none"> NBS benefits are communicated to politicians, urban managers, and civil society groups to create support and understanding of the NBS importance; measures are implemented to get broader knowledge sharing on designing and evaluating NBS; a shared understanding of NBS's importance and benefits is achieved. | [17,21,38,48,72,74,75] |
| | Are skills and expertise for NBS improved? | <ul style="list-style-type: none"> through certain measures, communities (especially civil society groups) are gaining expertise and improving their skills in the ways of managing, operating, and sustaining their involvement in NBS projects. | [20,32,49,92] |
| Stakeholder involvement and participation | Are all groups of stakeholders well-represented and equally involved? | <ul style="list-style-type: none"> multiple stakeholders are involved in the NBS process and their participation is meaningful and empowering; the process of participation is legitimate, produces social innovations, and generates ownership and stewardship of NBS; civil society is empowered to participate in decision-making (meaning they have enough capacity and ecological responsibility); the planning team organizes a socially inclusive planning process to include various stakeholders in collaborative forms of knowledge co-production. | [6,8,10,29,37,45,49,69,70,38,30,3,35,11,12,17,20,32,34,40,54,55,59,63,72,74,76-78,81,83,85,86,93,94,97,98,101,108] |
| | Are the stakeholders' perspectives recognized? | <ul style="list-style-type: none"> perspectives of various generations, refugees, immigrants, and people with special needs are integrated; various knowledge, norms, perceptions, and values of stakeholders are revealed and incorporated into NBS processes (incl. co-benefits of NBS and potential trade-offs); diverse perspectives on the value of human-nature relationships are integrated through inclusive/polycentric/multi-level governance. | [1,37,43,3,35,32,11,12,34,40,63,71-73,82,83,85,91,96,98,101,109] |
| | Are there enough opportunities and space for multi-stakeholder collaboration? | <ul style="list-style-type: none"> various opportunities (e.g., learning, funding, cooperation, partnerships) are provided to allow stakeholders to participate, gain recognition, and avoid or reduce potential conflicts; there are certain spaces where researchers, policymakers, practitioners, and other stakeholders can collaborate in inclusive processes of knowledge co-production. | [45,37,29,71] |
| | Are necessary measures taken to build trust? | <ul style="list-style-type: none"> measures are implemented to build trust between different actors (e.g., public authorities/decision-makers and local community) to balance interests and concerns of stakeholders around NBS; measures are undertaken to address scepticism and "fear of the unknowns" regarding NBS compared to traditional/grey infrastructure. | [70,32,75] |
| | Is cross-sectoral collaboration achieved? | <ul style="list-style-type: none"> NBS intervention integrates urban agendas, bridges knowledge across different governance sectors and departments, and resolves disputes; NBS facilitates interconnections and initiates collaborations among previously siloed areas, sectors, and applications of NBS; NBS uses inclusive research frameworks and interdisciplinary approaches. | [1,30,41,69,35,32,85,71,17,76,96] |
| Inclusive NBS design | Is NBS accessible to the target end users? | <ul style="list-style-type: none"> inclusive design of NBS makes it accessible to and usable by as many persons as reasonably possible. | [3,12,74,81-83,109,96,92] |
| | Is the chosen governance model ensuring NBS accessibility? | <ul style="list-style-type: none"> inclusive NBS governance recognizes and redresses inequalities in access to NBS and disparities that perpetuate dominant views about what nature is and for whom nature is produced and maintained. | [35,36,42,63,70,73,76,91,109] |
| | Is inclusivity considered in NBS planning and policy? | <ul style="list-style-type: none"> policies are created to protect vulnerable residents, ensuring that NBS projects provide environmental and social benefits without driving displacement. | [8,12,13,28,32,81,93,97,73,88] |
| | Are NBS designed for inclusivity? | <ul style="list-style-type: none"> multiple inclusive design options are presented and discussed with stakeholders; design of NBS ensures that NBS is tailored to local needs and specific contexts; | [3,11-13,17,28,32,34,42,59,76,78,81,82,85,86,88,97,98] |

(continued on next page)

Table 2A (continued)

| Thematic areas | Navigating questions | Recommended measures | References |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Benefits, burdens and impact | Are NBS promoting equitable and just outcomes? | <ul style="list-style-type: none"> diverse minority and marginalized groups are involved in NBS design and implementation. various factors (e.g. location, architecture, typology, selection of green species, and environmental conditions) are considered to ensure that NBS are tailored to specific contexts, promoting equitable and just outcomes. | [3,17,22,30] |
| | Does NBS deliver multiple benefits to all? What are potential dis-benefits? | <ul style="list-style-type: none"> NBS benefits and co-benefits are fairly distributed among various stakeholder groups and determined by societal needs and interests; co-benefits provided by NBS can contribute to social and environmental justice by delivering affordable and multifunctional solutions; potential disbenefits, burdens, or unintended consequences that might arise from the implementation of NBS are identified and considered; vulnerable groups that can be most affected by them are defined, and respective measures are proposed. | [3,6,10,11,13,21,22,28,37,38,40,43,54,70,73,74,76,77,82,84–86,88,93,108] |
| | Does NBS improve the living conditions of all? | <ul style="list-style-type: none"> design and implementation of NBS improve public health and living conditions of all societal groups, especially from deprived districts, and neglected or abandoned areas. | [3,31,49] |
| | Does NBS enhance social cohesion and social integration? | <ul style="list-style-type: none"> social cohesion is fostered due to shared spaces delivered by NBS where people can come together to engage in various activities, socialize, and experience mental health benefits of nature; shared experience can strengthen community ties, as people come together to plan for a better future. | [3,31,45,74,101,63,77] |
| | Does NBS provide economic opportunities? | <ul style="list-style-type: none"> NBS creates job opportunities, particularly in green industries (e.g., ecotourism, urban farming) that in turn can uplift communities economically while reducing inequality; green jobs and sustainable livelihoods provide a pathway for marginalized groups to become more integrated into communities. | [3,6,7,15,33,36,78,90,97,110] |
| | Does NBS enhance local identity and contribute to cultural preservation? | <ul style="list-style-type: none"> NBS is aligned with traditional knowledge and practices, especially in rural or Indigenous Communities; cultural and natural heritage is incorporated into NBS (e.g., through traditional farming) to preserve local identities and increase a sense of responsibility for local environment. | [3,8,10,19,38,109,72,39,83] |
| Does NBS empower the community? | <ul style="list-style-type: none"> stronger social networks are established, a sense of shared ownership is built, and shared responsibility for maintaining both environment and social bonds is created. | [21,59,63,81] | |

Data availability

Data will be made available upon request.

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