



Social Impact Framework for Nature-Based Solutions

Evidence brief of NbS services promoting local biodiversity,
well-being and scalable solutions (NBSPLUS) project

April 2026

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Co-funded by
the European Union

Key messages

- **Nature-based Solutions (NbS) can deliver substantial benefits for human wellbeing and physical health, particularly when intentionally designed and integrated into social contexts.**
- **NbS should be designed and governed as social-ecological systems, not just as blue-green infrastructure, because social processes are as important as the physical elements in shaping impacts and outcomes.**
- **Equitable access, inclusive governance, and sensitivity to local conditions are central to successful multi-functional NbS.**
- **The potential of NbS to maximise wellbeing benefits while maintaining or enhancing biodiversity is context-dependent and requires further research.**
- **Monitoring and evaluating social impact helps to prioritise actions, demonstrate value, and ensure that NbS contribute to wellbeing, resilience, and fairness over time.**

Introduction

Nature-based solutions (NbS) harness natural processes to address urban and regional challenges by tackling climate change, biodiversity loss, and contributing to societal wellbeing (UNEA, 2022). In this

evidence brief, societal or human wellbeing refers to the combined physical, mental, socio-cultural, and economic conditions that enable individuals and communities to thrive within just and resilient social-ecological systems (EEA, 2021).

NbS, such as parks, wetlands, green roofs, restored waterways, and other blue-green spaces, use natural processes to address urban challenges while enhancing biodiversity and delivering multiple social benefits (EEA, 2021). Blue-green areas refer to spaces that integrate vegetation and water elements, such as parks, wetlands, and rivers to support key ecosystem functions. In this context, social impacts refer to the effects of NbS on people's health and wellbeing, social relations, participation and governance, knowledge and capacities, and equity and justice at individual and community levels (EC, 2021; EEA, 2021; OECD, 2023).

Biodiversity refers to the variability of life on Earth, including the diversity of genes, species, and ecosystems, and the interactions among them (Romanelli et al., 2015; IPBES, 2019; WWF, 2024).

This evidence brief aims to support local level planning and policymaking, and to improve understanding among relevant stakeholders across sectors and disciplines of how NbS influence societal wellbeing, and how their positive social impacts can be intentionally designed, governed, and assessed in practice. Our social impact framework consists of the following categories of impacts: general physical and mental health and wellbeing; recreational value; place attachment; knowledge and learning; pro-environmental behaviour and

attitudes; social interaction and cohesion; recognitional and distributive justice; economic value; economic value and food security; meaningful participation; and procedural justice and empowerment (see Figure 14).

While NbS are increasingly promoted for their potential to address multiple challenges simultaneously, their benefits are not automatic and work best when intentionally designed. Critical aspects such as the just distribution of benefits, systemic trade-offs, and the role of biodiversity are frequently overlooked, limiting the ability of planners and policymakers to fully capture and leverage the social impacts (Mahmoud et al., 2021).



Figure 1: The pie chart depicts the societal challenges (SC) directly related to the social impacts of NbS, focusing on the People and Prosperity dimensions (adapted from EC, 2021). The social impacts identified in the brief are organised according to these challenges.

Methodology

Within the NBSPLUS project, as part of working package 4 on NbS services for human wellbeing, we conducted a review of literature published between January 2020 and October 2025 to examine recent evidence on the social impacts of blue-green infrastructure and biodiversity.

We then conducted a thematic analysis to identify the social impacts on human wellbeing and justice and organized the social impact themes according to the societal challenges (SC) under the People and Prosperity pillars of the European Commission NbS evaluation framework (EC, 2021). More information on our methodology, results and references is available in the accompanying **supplementary information slides¹**.

Societal challenge 1: Health and wellbeing

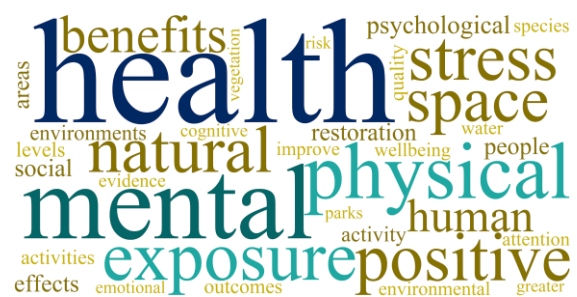


Figure 2. Word cloud illustrating the most frequent words in analysed literature addressing health and wellbeing.

General health and wellbeing

Overall, nature and biodiversity act as foundational assets for general wellbeing

¹ Link to supplementary slides.

when well-integrated into everyday urban environments. Blue-green spaces support general health and wellbeing by improving both physical and mental health outcomes. This is supported by evidence from research on therapeutic and nature-prescription contexts.



Figure 3. Exposure to nature supports physical health as well as mental health and wellbeing (SEI Tallinn/Heidi Tuhkanen).

Physical health

Blue-green spaces can positively impact physiological health by strengthening key systems in the human body (cardiovascular, immune, respiratory, stress and thermoregulation) and through reducing exposure to environmental hazards (Marselle et al., 2021). The benefits can depend strongly on characteristics like type of NbS, level of spatial quality, and accessibility. One significant impact of blue-green spaces is the promotion of physical activity by providing an attractive setting for movement, which can reduce the incidence of lifestyle disease risks. The outcomes can differ between age groups. For children and youth, contact with nature can promote physical activity and overall wellbeing, whereas the absence of such

spaces is connected to being physically inactive, obesity and poor sleep quality. For elderly people nature-based activities can have a positive impact on cardiovascular health and mobility but also carry the risk of injury.

Biodiversity, as a fundamental component of healthy ecosystems, reinforces many of the benefits outlined above. Here, it is useful to distinguish between actual biodiversity and perceived biodiversity. Actual biodiversity underpins healthy ecosystem functioning and supports processes that sustain life, such as water purification, pollination, and disease regulation, in turn contributing to food security, clean water, medicines, climate stability, and human health and wellbeing (Bastian, 2013; Romanelli et al., 2015; Williams et al., 2021; WWF, 2024, Marselle et al., 2021, Wu et al., 2025). Perceived biodiversity, on the other hand, refers to how people experience or notice biodiversity in their surroundings. Because most people cannot directly perceive ecological metrics, such as microbial diversity or genetic variation, perceived biodiversity is often based on visible or sensory aspects of nature. Examples include the presence of plants and animals, natural sounds, smells, or the overall naturalness and richness of a landscape (Castañeda et al., 2024; Felappi et al., 2020; Ribeiro et al., 2024). While perceived biodiversity and measured biodiversity are often related, they do not always align. For example, ecosystems may support high levels of ecological diversity that are not easily perceived (e.g., soil microorganisms). At the same time, emerging evidence suggests that perceived biodiversity may, in some contexts, be more closely linked to mental health and wellbeing than

measured biodiversity (Rozario et al., 2025).

More biodiverse environments support immune function through exposure to diverse microbiota and natural compounds, helping to regulate inflammation in the human body (Williams et al., 2021). Conversely, biodiversity loss and reduced exposure to well-functioning ecosystems can negatively impact human health and wellbeing and weaken immune function. However, measures to increase biodiversity may also lead to negative impacts, for example through greater exposure to allergens, pests, or disease vectors.

Mental health

Exposure to nature consistently improves psychological wellbeing, reducing stress, anxiety, and depression, while enhancing mood, attention, and cognitive performance, leading to increased happiness and satisfaction (Callaghan et al., 2021). Both everyday encounters and structured nature-based interventions, such as walks, gardening, forest therapy and nature prescriptions, deliver meaningful wellbeing gains across age groups and urban contexts. Positive effects on mental health are documented for forests, parks, wetlands, gardens, street greenery, and blue spaces. Benefits have even been observed from viewing nature through a window (Soga and Gaston 2025) or through virtual reality sensory experiences (Frost et al., 2022). Exposure to natural environments is important for relaxation, as well as cognitive and emotional restoration (Patuano, 2020). Physical activity in nature can also improve

cognitive abilities, support attention restoration, and enhance creativity (Remme et al., 2021).



Figure 4. Nature exposure supports mental health, cognitive functioning, and wellbeing. (SEI Tallinn/Kaidi Tamm).

Greater biodiversity or perceived biodiversity in natural areas can further strengthen positive effects on mental health, and reduce stress, while limited access to such spaces may weaken them. For example, exposure to biodiverse natural environments supports emotional restoration, and attention restoration. Further, more biodiverse spaces, such as those with greater avian and habitat diversity, are associated with increased happiness and satisfaction (Cameron et al., 2020).

However, evidence is mixed on whether measured levels of biodiversity consistently improve mental health, e.g. the role of biodiversity in improving cognitive abilities (e.g. Borca et al., 2023; Wu et al., 2024). Biodiversity-related disservices, such as fear, safety concerns, or disease risks, can diminish or even reverse wellbeing gains. For example, the stress-reduction benefits of nature may be lower in contexts where biodiversity-

supporting measures, such as urban meadows, generate perceived risks or fear, including concerns about ticks or reduced visibility (Paudel and States, 2023).

Moreover, in some cases, it remains unclear whether and which human wellbeing benefits are a result of perceived biodiversity or measured biodiversity (Yuille et al., 2024).

Thus, biodiversity influences many aspects of nature-related diversity that influence human wellbeing in distinct ways, but its role in shaping wellbeing requires further investigation.

Societal challenge 2: Place regeneration



Figure 5. Word cloud illustrating the most frequent words in the analysed literature addressing place regeneration.

Place regeneration refers to overcoming the negative effects of urbanization, such as overdensification, brownfields or lack of investments in some neighborhoods, to (re)create resilient, and socially inclusive urban spaces that improve wellbeing. By enhancing the quality of urban spaces, NbS support place regeneration through recreation, place attachment, place identity, and stronger connections to nature.

Recreational value

Various types of NbS, such as wetlands, parks, forests, and even urban wastelands, provide opportunities for recreation, including sports and social activities. However, specific attributes of these spaces and how others use them shape people's perception of their quality and safety (Yuan & Chen, 2025), how they use them (Amorim et al., 2021) and whether they feel connected to them (Bertoletti et al., 2025). Accessibility, or the "ease of reaching [a space] by overcoming spatial barriers while considering the cost, time, and distance of transportation" (Huang et al., 2023) and perceptions play a role in mediating the frequency and purpose of their use. For example, in some cultural contexts, more natural-looking landscapes are perceived as being of higher quality, while in other cultures, higher quality is associated with highly managed landscapes and more natural spaces are conversely associated with fear or perceived lack of safety.

In general, aesthetic preferences and the perceived quality of natural areas shape whether and how they are used (Bele & Chakradeo, 2021; Allegretto et al., 2022). The varying preferences for and perceptions of users is a challenge for NbS designers.

Place attachment

Place regeneration can also lead to a stronger sense of place identity, reflecting how people identify with and respond emotionally to a place. This can be directly beneficial by fostering feelings of belonging, and indirectly beneficial by

encouraging people to visit natural spaces they feel attached to, thereby supporting their health and wellbeing. Place attachment and connection to nature can be strengthened through better access to and increased use of blue-green areas (Ode Sang et al., 2022).



Figure 6. Healthy and biodiverse blue-green spaces enhance the perceived quality of urban nature, supporting place attachment and connection to nature (SEI Tallinn/ Heidi Tuhkanen).

Societal challenge 3: Knowledge and social capacity



Figure 7. Word cloud illustrating the most frequent words in the analysed literature addressing knowledge and social capacity.

Addressing complex issues, such as climate change, biodiversity loss and social inequality requires the generation and application of diverse knowledge and collective cooperation across society. NbS can contribute to this societal challenge by shaping users' attitudes and behaviours towards more pro-environmental orientations, while also providing spaces and opportunities for knowledge and learning.

Environmental awareness and attitudes

Spending time in natural spaces and developing a connection to them has been linked to positive attitudes towards nature and increased affection for nature. The enjoyment derived from interacting with plants through recreational activities, such as gardening, can further deepen people's connection to and appreciation for natural spaces (Zedda, 2023). For children in particular, frequent and meaningful experiences in nature are important for developing long-term pro-environmental attitudes. Reduced opportunities to experience biodiverse and well-functioning ecosystems can weaken one's connection with nature (Zandersen, 2024), which can have negative consequences for health and wellbeing (Barbiero & Berto, 2021).

Pro-environmental behavior and stewardship

Greater connectivity with nature can encourage pro-environmental behaviour and stewardship. A deeper relationship with, and knowledge of, nature are both important in motivating people of all ages

to engage in conservation efforts (Straka et al. 2025). The literature indicates that older age groups demonstrate stronger species identification skills, higher nature relatedness, and greater intentions to engage in pro-conservation behaviour compared with younger age groups (Straka et al. 2025). Furthermore, greater nature connection is associated with pro-environmental behaviors (Cooley et al. 2020) and individuals in natural environments exhibit more altruistic behavior (Barbiero & Berto, 2021).



Figure 8. Participating in citizen science activities offers a chance to learn about nature (SEI/Heidi Tuhkanen).

Awareness, knowledge and skills development

Educational opportunities focused on natural environments, biodiversity and observing ecological processes can play an important role in engaging communities in NbS planning and improving decision-making about nature (Coman et al., 2022). This is especially true when education extends beyond traditional classroom

instruction and creates opportunities for collective engagement.

Learning through nature with activities such as community gardening, foraging and place-based learning can foster awareness and appreciation of nature, introduce people to multiple species and their value and give insights into ecological processes (Stagg & Dillon, 2022).



Figure 9. Learning through nature can foster appreciation of nature and contribute to nature conservation (SMHI/Iris Ljungkvist).

Education focused on biodiversity, such as identifying outdoor species or observing habitats, builds awareness of the interrelationships between humans and nature (Zedda, 2023) and can empower people to participate in conservation efforts (Straka et al., 2025). However, human awareness of species is often biased towards more charismatic species (Nguyen et al. 2023). Educational programmes can also broaden awareness by highlighting the importance of the less visible and less charismatic species (Quinney 2020).

Incorporating local and traditional knowledge through engaging community stakeholders, including local residents, Indigenous peoples (where relevant), and researchers, can provide a strong foundation for ecological restoration while also supporting local culture and identity (Hall et al., 2021).

Societal challenge 4: Social justice and cohesion



Figure 10. Word cloud illustrating the most frequent words in analysed literature addressing social justice and cohesion.

Climate change intensifies environmental pressures on humans, such as heat stress, risk of floods and drought, pollution and poor air quality. These and other stressors disproportionately affect vulnerable groups and exacerbate social fragmentation (IPCC, 2023). Equitable access to better performing ecosystems can help mitigate these effects. When NbS are designed incorporating elements of both recognitional and distributive justice, they can improve social cohesion and lead to more equitable outcomes.

Social cohesion

Urban blue-green spaces strengthen social interaction and cohesion by providing settings for both spontaneous encounters and organized community activities (Khalaji et al., 2024). These shared spaces help reduce loneliness, support the development of social capital and relationships, and are especially valuable for potentially marginalized groups, such as immigrants (Smith & Turner, 2023). Active engagement with nature, such as community gardening or volunteering, further enhances social cohesion while offering co-benefits like improved food security and transfer of knowledge and skills. Blue-green areas are also an important environment for cultural events which influence community spirit (Pandey & Ghosh, 2023). Social interaction and activities in blue-green areas can also contribute to improved health and wellbeing. Environments that are accessible, diverse, and perceived as safe and of high quality are most likely to foster social cohesion.

Recognitional and distributive justice

In order to promote social justice, NbS planning processes should address the intertwined dimensions of recognitional and distributive justice. Recognitional justice involves acknowledging diverse cultural values, local identities, and different relationships with nature. Planning processes should account for the needs of different groups, including those with limited mobility, elderly, women,

children, Indigenous peoples, and socio-economically marginalized residents.

At the same time, distributive justice concerns how environmental benefits and risks are shared across society. For example, socio-economically marginalised residents in urban areas often have less access to good environmental quality blue-green spaces and biodiverse natural environments (Methorst et al., 2021). They also tend to live in higher-risk environments, e.g. floodplains, coastal zones, and environmentally degraded areas (Hallegatte et al., 2017), and face greater exposure to environmental hazards including heat, flooding, and pollution (Robinson et al., 2024), further compounding the inequities.

Ecosystems play a role in influencing human wellbeing within this category. Higher levels of societal inequality have been associated with lower levels of biodiversity (Marselle et al., 2021) and areas with lower biodiversity may be less ecologically healthy and thus more susceptible to ecological disturbance (Wu et al., 2024). This points to the accumulation of environmental and social stressors in lower biodiversity areas and lower-quality settlements. Evidence indicates that the health and wellbeing benefits of biodiverse environments may differ depending on demographic and socio-economic characteristics, including age, gender, and income (Blaschke et al., 2024; Seastedt et al., 2025). In particular, women, older adults, and people from lower socio-economic backgrounds may experience disproportionate health benefits from exposure to higher quality green spaces, e.g. spaces that are

biodiverse, accessible, safe, clean, and designed to promote use (Robinson et al., 2024). Also, communities may suffer extraordinarily from the loss of biodiversity, e.g. of cultural keystone species, due to their reliance on them or their special relationship with them (McInturff et al., 2025).

Displacement of users and activities

Decision-making processes should incorporate diverse groups of stakeholders, acknowledging that NbS may sometimes have unintended negative consequences, such as those leading to displacement of people or activities. For example, eco-gentrification, the situation where environmental improvements increase living costs leading to displacement of longtime residents with lower incomes, is a negative side-effect of the increase in property values close to NbS sites. This can be mitigated through forward-looking policies (Schell et al., 2020), e.g. related to housing.

Tensions may also arise where conservation approaches shaped by Western values conflict with Indigenous peoples' traditional land-use practices (McFadden, 2022). Ensuring distributional justice means providing equitable access to nature and its health benefits, especially for lower-income communities.

Societal challenge 5: Economic and livelihood opportunities



Figure 11. Word cloud illustrating the most frequent words in analysed literature addressing economic and livelihood opportunities.

Economic considerations play a central role in guiding decision-making and justifying investments. NbS interventions contribute to more resilient, inclusive, and sustainable local economies through the generation of economic value, but also through improving food security.

Economic value

NbS can be a source of economic benefits for residents. In urban settings, residents and investors benefit directly from NbS because they increase the value of nearby properties (O'Brien et al., 2022). NbS measures also provide services that would otherwise have to be paid for – decreasing costs related to, e.g. run-off treatment, groundwater treatment, and cooling urban areas. In the case of cooling, NbS, such as urban trees, can reduce the need for air-conditioning in a warming climate (Li et al., 2024), while also supporting climate mitigation efforts. By enhancing biodiversity or ecological quality and

contributing to a better functioning ecosystem, NbS also help mitigate or avoid costs through improving resilience, e.g. decreasing susceptibility of nature to pests and disease (Hardberger et al., 2025). Economic benefits can also be derived from economic activities tied to the use of nature (Paudel & States, 2023), e.g. medicinal plants, food production or hunting licenses.

Livelihood and food security

Urban and peri-urban food production, e.g. through community gardening, can support the local food supply. It can reduce food poverty through saved food costs and help lower-income populations attain healthy diets (Tharrey & Darmon, 2021). There can even be employment opportunities generated through production and sales of nature-based goods, as well as the development and maintenance of NbS (Shackleton, 2021).

Societal challenge 6: participatory planning and governance



Figure 12. Word cloud illustrating the most frequent words in analysed literature addressing participatory planning and governance.

Existing governance approaches are often insufficiently inclusive, collaborative or adaptive, which can lead to an uneven distribution of NbS benefits and disadvantage marginalized communities. Within NbS planning, these issues can be addressed by enabling meaningful participation of diverse and relevant stakeholders and by incorporating feedback throughout the planning and implementation phases (Lam et al., 2024). These mechanisms have broader societal impacts and can enhance the legitimacy and acceptance of NbS interventions.

Meaningful local participation

Recognising the diversity of perspectives in the planning of blue-green infrastructure (recognitional justice) supports procedural justice, which refers to who participates in decision-making and how inclusive or fair those processes are. When groups are not recognised, they are often unable to participate meaningfully in planning processes. Community engagement in NbS design processes increases the diversity of voices in decision-making and supports the inclusion of otherwise overlooked stakeholders (Pandey & Ghosh, 2023).

Participatory planning and governance are essential for achieving justice and effectiveness in NbS. It is important to engage a broad range of stakeholders, especially local residents and vulnerable groups early, continually, and in an empowering way that enables them to influence decision-making. Co-creative processes and community-led interventions can be supported by innovative governance approaches, e.g. collaborative multi-actor governance, that

build trust, help ensure the equal distribution of the NbS benefits, and enhance planning outcomes (Buijs et al., 2016). These can increase the social acceptability and legitimacy of decisions (Khalaji et al., 2024; McInturff et al., 2025) and motivate local stewardship. This requires a change from traditional top-down governance related power dynamics (Razzaghi Asl & Pearsall, 2022), and may require building the capacities of those being engaged for increased bottom-up activity.



Figure 13. Meaningful stakeholder participation and feedback mechanisms increase acceptance and legitimacy and are key to achieving equitable NbS outcomes (Kaidi Tamm/SEI).

Transparency and accessible feedback mechanisms

Empowerment and giving voice to marginalized perspectives rely on feedback and grievance mechanisms that are accessible and culturally appropriate (Lam et al., 2024). Such mechanisms should be

implemented throughout the NbS planning and implementation cycle to support implementation and maintenance. The process can be supported by transparency, accessibility of information (Suich and Dawson, 2023) and clear definition of stakeholder roles.

Discussion

Based on the review presented above, we develop a social impact framework that synthesizes the key impacts identified in the previous sections. Although impacts depend on many factors and are always location- and context-specific, we did find interrelations between them. For example, impacts related to participation (see A in figure 14) can influence impacts in B, C, D, E and ultimately F categories. Our findings confirm that NbS can deliver significant social benefits that help address several

societal challenges. The identified impacts highlight a subset of the impacts identified in the European Commission handbook (EC, 2021), with the most overlap in the impacts related to health and wellbeing impacts (SC#1), knowledge and social capacity (SC#3) and intermediary impacts related to social justice and social cohesion (SC#4). However, we also identified additional areas of impact related to integration of Indigenous knowledge (SC #3) and the role of biodiversity (across SC categories). Although these topics may be explored in other disciplines, they are understudied in terms of their role in holistic implementation of NbS. Our findings also move beyond the EC report (EC 2021) by highlighting the interrelations between the different impact aspects. We will further explore this through systems dynamic modelling. Our review indicates that benefits are not automatic. Social impacts depend on how NbS are designed, governed, and embedded in local contexts, rather than on the ecological aspects alone.

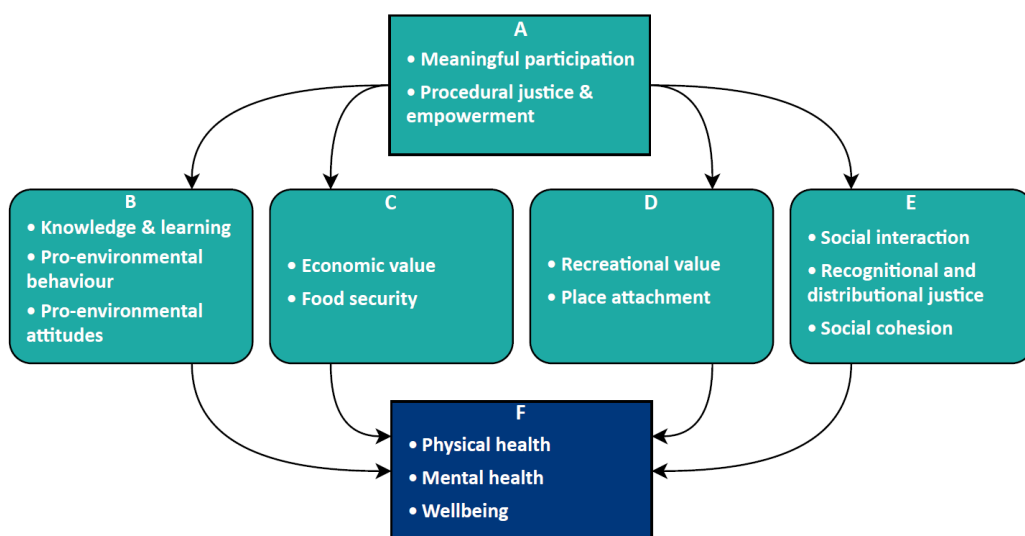


Figure 14: Social Impact Framework reflecting the various clusters of impacts and their interactions based on the findings of the literature review

Municipalities should therefore approach NbS as social-ecological systems, where physical design, biodiversity, and social processes jointly shape impact and outcomes. Across the social impact areas, accessibility, perceived quality, and safety were found to mediate wellbeing outcomes. The presence of well-functioning biodiverse ecosystems can enhance wellbeing and place attachment, but in some cases, the effects depend on how nature is perceived and experienced. Our findings indicate mixed evidence regarding the impacts of biodiversity and varied definitions of biodiversity in the literature reviewed, highlighting this as an important area for future research.

The findings demonstrate that social processes are key pathways for social impact. Participation, co-creation, stewardship, and learning influence how NbS are designed, perceived, used, valued, and maintained, and whether benefits are equitably distributed. Insufficient attention to recognitional, procedural, and distributive justice creates a risk of NbS reinforcing inequalities or contributing to unintended outcomes.

This review is not systematic due to resource constraints within the project. Other key limitations include its focus on recent literature, high-income countries, urban, and peri-urban contexts. We therefore suggest that future empirical research further explore rural contexts more fully and examine the links between biodiversity and social impacts. This could include differentiating among the social impacts of specific types of biodiversity (Davis et al. 2025) (e.g. diversity in species or habitats in general, proxies related to specific species, such as birds, or even

perceived biodiversity) in different contexts. Another important area for further research is how to influence perceptions or address concerns related to use of specific types of less intensively managed, more biodiverse nature. Additional areas with mixed evidence, such as nature's impact on cognitive performance, or lower levels of research in impacts related to economic and livelihood opportunities, also provide fruitful avenues for future research.

Finally, it should be recognised that this review only briefly engages with many concepts, such as place attachment, stewardship, and poverty reduction, which have been explored in more depth in other disciplines.

Next steps

The overall aim of the evidence brief is to make it easier for local decision-makers to understand the broad range of potential social impacts that NbS interventions provide, as well as their mediating factors. This understanding can support decision-making related to NbS planning.

Within the NBSPLUS project, the next step is the further elaboration of the social impact framework and the identification of indicators for each of the main impact areas. The framework, together with ongoing interdisciplinary efforts within the NBSPLUS project, supports the development of the *NbS services* concept. The framework will be applied to evaluate the social impact of NbS regarding the balance among biodiversity protection/enhancement and human

wellbeing in three case studies (Malmö, Sweden; Lachute, Canada, and Valencia, Spain) using a resident survey. Additionally, we will conduct citizen science activities and focus groups to equitably integrate stakeholder perspectives into decision-making. Based on insights from these cases, the framework will be revised to ensure applicability to cases external to the project.

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Reference for this evidence brief: Tuhkanen, H., and Tamm, K. 2026. Social Impact Framework for Nature-Based Solutions: Evidence Brief. NBS services promoting local biodiversity, wellbeing and scalable solutions project deliverable 15. NBSPLUS project.

Title image: SEI Tallinn/Kaidi Tamm

Acknowledgements: the authors would like to thank Max-Emanuel Müller, Valentin Bayas, Shimin Huang, as well as NBSPLUS consortium including Ursula McKnight, Luciana Zedda, Sebastian Höss, Katarina Cetinik, and advisory board members Laura Wendling, Jill Slinger, Tricia Stadnyk and Erik Andersson for their contributions to this brief.

This evidence brief was written by Stockholm Environment Institute Tallinn Centre with funding from Biodiversa+, co-funded by the European Commission, and the Estonian Research Council (ETAG).

This research was funded by **Biodiversa+**, the European Biodiversity Partnership, in the context of the **NBSPLUS project** under the 2023-2024 **BiodivNBS** joint call. It was co-funded by the **European Commission (GA No. 101052342)** and the following funding organisations: The Swedish Research Council for Environment, Agricultural, Sciences, and Spatial Planning (Formas), Fundação para a Ciência e a Tecnologia, I.P., Research Council of Norway, Agencia Estatal de Investigación; Fundación Biodiversidad, Estonian Research Council (ETAG), Fonds de Recherche du Québec (FRQ). IBN, partner and subcontractor, has been co-financed by FORMAS, Agencia Estatal de Investigación; Fundación Biodiversidad, and FRQ.



Co-funded by
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