Valuing Inclusion and Diversity, Embracing Uncertainty: Ways Forward for Nature-based Solutions

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Abstract

There is a growing consensus that working with nature can help to address the pressing interlinked climate and biodiversity challenges, while ensuring and enhancing human well-being. Though being driven primarily by climate change mitigation and increasingly adaptation, Nature-based Solutions (NbS) are now also widely endorsed as cost-effective means for protecting biodiversity and for promoting a thriving society. Despite their great promises, the implementation and mainstreaming of NbS face several entrenched challenges, including unequal powers in shaping discourses and practices, persistent silos in knowledge and decision-making, as well as considerable uncertainties in terms of the performance and effects of NbS. To promote their wider uptake and unleash their full potentials require valuing *inclusion and diversity* that underlie the concept of NbS and embracing *uncertainty* that is inherent to nature. Whilst NbS are unquestionably an important and powerful ally, they are not a panacea that can tackle the pressing climate, biodiversity and wider sustainability challenges alone. With humanity at a critical juncture, where climate and biodiversity predictions grow more dire, every action that can make a difference need to be taken.

Introduction

Recent years have witnessed the rapid and significant rise of nature-based solutions (NbS) in global environmental governance debates. While international landmark assessment reports such as the Climate Change and Land Report of the Intergovernmental Panel on Climate Change (IPCC),[1] the Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES),[2] and the Global Adaptation Commission Report[3] expose the grim reality of climate change and biodiversity loss, they also endorse NbS as a viable way in addressing these and other sustainability challenges faced by all mankind. Corresponding, NbS are gaining traction in science and policy, with a growing number of initiatives launched and implemented to research and practice on it.

The concept of NbS is relatively new and is constantly evolving. The IUCN (International Union for the Conservation of Nature) defines it as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits".[4] Similarly, the European Commission defines NbS to societal change as solutions that are "inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions".[5] Although phrased differently, these and many other interpretations commonly regard NbS as an integrated approach that works with nature to bring multiple benefits to climate, people, and nature.

The concept of NbS is *inclusive* in terms of the wide range of actions it encompasses, the actors it involves, and the sites in which it takes place. Examples of NbS include protecting and restoring natural and semi-natural habitats such as peatlands and woodlands to absorb carbon dioxide, incorporating green and blue infrastructures in urban areas to manage water risks, and applying ecosystem-based principles to agricultural systems to secure biodiversity. The often project-based, experimental form of NbS also recognize the capacities of different actors, encouraging them to lead or to engage in various actions that mobilize nature for sustainability, complementing the conventional *regulatory* and *planning* modes of environment governance that often fall under the responsibility of public authorities.[6] The breadth of the term as well as its great promises arouse a great deal of public interests and motivates a wide range of exploration and critical examination of its applications and effects.

1 IPCC (2021) *Climate Change 2021: The Physical Science Basis.* IPCC Sixth Assessment Report. Available at: https://www.ipcc.ch/report/ar6/wg1/

2 IPBES (2019) *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673

3 Global Commission on Adaptation (2019) *Adapt Now: A Global Call for Leadership on Climate Resilience.* Available at: https://gca.org/reports/adapt-now-a-global-call-for-leadership-on-climate-resilience/

4 Cohen-Shacham E, Walters G, Janzen C & Maginnis S. (2016). *Nature-Based Solutions to address societal challenges.* http://doi.org/10.2305/IUCN.CH.2016.13.en.

5 European Commission (2016) *Policy Topics: Nature-based Solutions.* https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en

6 Bulkeley H, Kok M, and Xie L (2021), *Realising the Urban Opportunity: Cities and Post-2020 Biodiversity Governance.* PBL Netherlands Environmental Assessment Agency, The Hague.

Research on NbS abounds and continuously grows. Existing studies have demonstrated the multiplicity of benefits that NbS can bring with, while also voiced concerns over its current narrow focus on certain type of benefits (such as tree planting for climate mitigation).[7] They also revealed a series of challenges for implementing and mainstreaming NbS, while proposing a set of detailed countermeasures and strategies.[8] This report engages these debates, building on the discussions that took place during the British Academy's workshops on NbS worldwide in July 2021, as well as drawing on existing NbS research and case studies. It first discusses the multiple benefits of NbS beyond climate mitigation and adaptation. It then discusses the entrenched challenges of current NbS framings, as well as their design, implementation and maintenance. Besides presenting the fundamental principles for unlocking the potentials of NbS, this report also argues that for addressing the planetary emergency of warming climate and collapsing biodiversity, all actions by all actors matter, including NbS and aggressive decarbonization efforts.

7 Seddon N, Turner B, Berry P, Chausson A, & Girardin CA (2019). 'Grounding nature-based climate solutions in sound biodiversity science'. *Nature Climate Change,* 9(2), 84-87.

8 Kabisch N, Frantzeskaki N, Pauleit S, Naumann S, Davis M, Artmann M, ... & Bonn A (2016). 'Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action'. *Ecology and Society,* 21(2).

The value of NbS: beyond climate change mitigation and adaptation

Whilst the term NbS is all-encompassing, it has been natural *climate* solutions that have tended to draw the most attention and drive its popularity. NbS contribute to mitigate climate change through both carbon capture and storage and by reducing the demand for fossil-fueled energy and mobility. It is estimated that NbS can provide around one-third of the cost-effective climate mitigation needed to achieve the 1.5°C target of the UN Climate Paris agreement.[9] Through conserving, restoring and or better managing ecosystems such as forests, mangroves, peatland moors, sea grasses, and agroforestry, natural climate solutions can reduce carbon release and enhance nature's ability to sequester and store carbon (see NbS example 1 in Box 1). Besides preserving and restoring natural carbon sinks, NbS such as urban green roofs and vertical greenings can also reduce energy demand, and thus the greenhouse gas (GHG) emissions, by cooling the built environment. In terms of adaptation, NbS hold great potentials in reducing socioeconomic exposure (or risks) and sensitivity (or impacts) by climate change, and in supporting socioeconomic adaptative capacity to respond to changing conditions (see NbS example 2 in below Box 1).[10]

Box No.1

NbS example 1: Mikoko Pamoja (Mangroves Together), Kenya
Mikoko Pamoja is a community-led mangrove conservation and restoration project started in 2013 in Gazi Bay, Kenya. It brings together two communities to sell carbon credits from mangrove conservation and reforestation. During 2013-2017, the project had avoided 12,000t CO2 emissions, and through the sale of carbon credits, more than US$36,000 had been channeled into the community to support sustainable community development and further conservation activities.

See more details: planvivo.org/mikoko-pamoja

NbS example 2: Inspiring Water Action in Torne (IWAIT), UK
In Doncaster in the United Kingdom, 46.5 hectares of wet-woodland habitat was restored and improved, acting as a natural aid to reducing flood risk by creating an estimated 4,000 cubic meters of extra storage space, soaking up the flow of rising waters, protecting around 1,000 nearby properties and agricultural land. Through this NbS project, 600 children and young people across seven schools, each linked with one of the woodland sites, can learn about flood risk, water quality and management, as well as ecology.

See more details: *una.city/nbs/doncaster/inspiring-water-action-torne-iwait*

9 Griscom et al. (2017). 'Natural climate solutions'. *Proceedings of the National Academy of Sciences,* 114 (44) 11645-11650; DOI: 10.1073/pnas.1710465114.

10 Seddon N, Chausson A, Berry P, Girardin CAJ, Smith A, Turner B. (2020) 'Understanding the value and limits of nature-based solutions to climate change and other global challenges'. *Phil. Trans. R. Soc. B* 375: 20190120.

Whilst few would dispute the valuable role played by NbS in addressing both the causes and consequences of climate change, their on-the-ground implementation and effects have aroused many concerns. Researchers found that the actual uptakes of NbS for climate change often narrowly focus on afforestation using fast-growing monocultures (even with non-native species), which risks not only compromising long-term carbon storage and reducing the potential to protect against flooding and fires, but also the safeguarding of biodiversity.[11] To prevent such abuse of the concept of NbS and to protect the integrity and stability of the natural system against practices that favor short-term gains, the International Union for Conservation of Nature (IUCN) launched the Global Standard for NbS in July 2020, emphasizing that "each solution must either maintain or enhance biodiversity, without which an action cannot be classified as NbS".[12] In this regard, benefiting biodiversity validates a solution as NbS, and this can be achieved through conserving and restoring habitats and species, and ensuring and enhancing nature's benefits for society.[13]

Generally speaking, NbS can contribute to biodiversity *conservation* by (1) protecting and enhancing habitats, which can be achieved through actions like improving existing ecosystems, building healthy new habitats, strengthening habitat connectivity, and reducing or avoiding negative impacts to ecosystems; (2) protecting species, which often involve both in-situ or ex-situ conservation measures (such as building breeding centers, botanical gardens and gene/seed banks) to protect native, endangered or valued species, as well as controlling and cleaning invasive alien species; and 3) enhancing conservation governance through policies (e.g., biodiversity offsets), education, capacity-building, and tapping traditional knowledge and conservation practices. For biodiversity *restoration*, NbS contribute to restore damaged or destroyed ecosystems, species, and ecological connectivity.

By conserving and restoring biodiversity, NbS have much more to offer. Apart from addressing climate change, NbS can deliver a wide range of social, cultural, economic, and environmental benefits. The beneficial contributions provided by NbS include food provisions, jobs creation, water purification, artistic inspiration, aesthetic enjoyment, religious and spiritual fulfilment, as well as the promotion of social cohesion, health and well-being, a sense of identify and the support to the local economy.[14]

NbS are distinguished by their multifunctionality. Whilst current discourses and practices tend to frame NbS primarily in climate term, it risks marginalizing the potential of NbS for other agendas (e.g., biodiversity). Moreover, it could lead to missed opportunities for creating synergies and even result in conflicts or redundancy. As it is widely advocated that climate change and biodiversity, as well as other sustainability challenges such as poverty and social injustice, should be addressed together, the design and application of NbS should take into considerations of multiple sustainability goals of the local contexts and beyond, minimizing trade-offs whilst maximizing synergies. Box 2 below provides examples of the great potentials of NbS in addressing a multiplicity of sustainability challenges while contributing to tackling climate change.

11 Seddon N, Turner B, Berry P, Chausson A, & Girardin CA (2019). 'Grounding nature-based climate solutions in sound biodiversity science'. *Nature Climate Change,* 9(2), 84-87.

12 IUCN (2020) *Guidance for using the IUCN Global Standard for Nature-based Solutions. A user-friendly framework for the verification, design and scaling up of Nature-based Solutions.* First edition. Gland, Switzerland: IUCN.

13 Xie L & Bulkeley H (2020) 'Nature-based solutions for urban biodiversity governance'. *Environmental Science & Policy,* 110, 77-87.

14 Díaz S, Pascual U, Stenseke M, et al. (2018) 'Assessing nature's contributions to people'. *Science* 359 (6373): 270-272.

Box No. 2

NbS example 3: Sustainable cocoa production in the ecoregion of Lachuá, Guatemala
In 2006, the IUCN jointly with Guatemala's Ministry of Agriculture, promoted the support of 170 cocoa producers for the initial development of 230 hectares of cocoa plantations. The aims of this project were to promote agroforestry restoration in the biological corridors of the Lachuá ecoregion, generate employment, improve people's livelihood, and at the same time, foster the conservation of the natural wonders of the area. By promoting agroforestry cocoa farming systems – where cocoa is grown together with trees, this project helps to substantially boost incomes, provides a habitat for other species, while mitigating climate change by absorbing carbon.

See more details: *iucn.org/regions/mexico-central-america-and-caribbean/cocoa-production-guatemala*

NbS example 4: The Alna Environmental Park, Norway
The Environmental Park project in Oslo, Norway runs along the river Alna, involving opening up rivers that previously were running in underground pipes. The central aims of this NbS project are to improve the self-cleaning ability of Alna, maintaining biodiversity in the region, providing recreational areas for citizens and inspiring future urban development. Whilst supporting biodiversity and improving water management and social health and well-being, the Park also contributes to Oslo's responses to climate change as the reopened river stretches serve to prevent flood. Moreover, the project also helps to safeguard cultural heritage as it restores and making places with cultural heritage value more accessible and available.

See more details: *una.city/nbs/oslo/alna-environmental-park*

NbS example 5: Floating gardens, Bangladesh
Floating agriculture is a traditional agricultural practice of Bangladesh, which uses plant materials to make floating rafts in waterlogged areas to raise seedlings and grow vegetables in monsoon months. Originated in the south-central wetlands of Bangladesh, this indigenous agro-practice system has since around2000 been extensively promoted by many NGOs and government agencies not only as a means of climate adaptation, but also of disaster risk reduction, livelihood option, nutritional security, and extreme poverty alleviation. This practice has also contributed to reduce pollution as it uses less or no agro-chemicals.

See more details: nbsbangladesh.info/case_study/floating-gardens/

NbS example 6: Building a green roof in an urban village, China in 2017
The Nature Conservancy (TNC) launched an innovative project named 'Green Cloud' and piloted a green roof renovation in an old building of the Gangxia village in Shenzhen. The project utilizes three-dimensional light steel structures that are simple to construct and have the capacity to hold over 420 plant containers, filled with plants mostly native to Southern China. It provides a green space to the densely populated urban village, serving as a space for social, recreational and educational activities for people of all ages. The green roof can retain over 65% of the rainfall, creating a stormwater management system that can absorb, purify, store and reuse rainwater. It also helps regulate room temperature within the building, reduces the urban heat island effect, improve air quality, and lower greenhouse gas emissions.

See more details: *thenatureofcities.com/2020/03/22/the-green-cloud-a-rooftop-story-from-shenzhen-a-living-sponge-space-inside-an-urban-village/*

Entrenched challenges for

The multifunctionality feature makes NbS an appealing and promising approach for simultaneously addressing climate and biodiversity challenges, while ensuring and improving human well-being. However, the application and mainstreaming of NbS face several entrenched challenges, including the *unequal powers* in shaping discourses and practices, the *persistent silos* in knowledge and decision-making, as well as the *uncertainties* in terms of the dynamic nature of ecosystems and thus the performance of NbS.

Power relations underpin policymaking and governance and determine access, use and management of ecosystem services.[15] NbS are shaped by, and in turn, form part of the political and power structures. The way NbS is framed determines whose knowledge matters and who is involved or excluded in research, policy and practice.[16] Established power structures are self-reinforcing, thus there are often limited spaces for innovative ideas and projects that can challenge and even disrupt current unsustainable thinking, doing and organizing, and for fostering collaborations that can harness the diversity of knowledge, worldviews and value for crafting context-specific, socially just, and synergistic solutions. Consequently, powerful actors and networks tend to dominate the discourses and practices of NbS, asserting their own interests whilst using NbS as 'fig leaf' to cover unsustainable and unjust economic and development activities.[17] Without adjusting the current flow of power, resources and materials, knowledge production and decision making could further reproduce unequal power relationships, hindering the design and implementation of effective NbS that can address the complex, cross-cutting social and environmental challenges. This could even jeopardize the effectiveness of innovative interventions and efforts and creating new inequality.

Whilst unequal power structures could result in overexploitation and misuse of NbS, causing more harm than good, institutional and knowledge silos and the uncertainties inherent in NbS constrain their buy-in by both public and private actors and impede their integrated design and on the ground implementation and maintenance. *Silos* between sectors and areas of expertise are big obstacles for integrated policies and practices towards sustainability. This is especially challenging for NbS since their multifunctionality means their benefits land in multiple policy domains and consequently different governmental departments such as energy, agriculture, transportation, housing, and health and security. Silos across different disciplines (such as biology, ecology, engineering, architecture, public health, and urban planning) also impede the exploration of integrated and cost-effective NbS for interconnected and complex sustainability issues. The inability to break institutional and knowledge silos could result in missed opportunities in reducing trade-offs, creating synergies, sharing responsibilities, and lowering costs and risks in developing and maintaining NbS.

15 Berbes-Blazquez M, Gonzales JA, Pasqual U (2016) 'Towards an ecosystem services approach that addresses social power relations'. *Curr Opin Environ Sustain* 19:134–143

16 Welden EA, Chausson A, & Melanidis MS (2021). 'Leveraging Nature based Solutions for transformation: Reconnecting people and nature'. *People and Nature.* 00: 1– 12. https://doi.org/10.1002/pan3.10212

17 Seddon N, Smith A, Smith P, Key I, Chausson A, Girardin C, House J, Srivastava S and Turner B (2021), 'Getting the message right on nature-based solutions to climate change'. *Glob. Change Biol.,* 27: 1518-1546. https://doi.org/10.1111/gcb.15513

Nature is a dynamic complex, constantly changing in a span of time. NbS are thus inherently full of *uncertainties*.[18] Comparing to grey infrastructure, which has established widely understood performance metrics and calculations of risks and impacts, NbS are relatively hard to assess and measure in terms of their (monetized) benefits and costs, as well as failure probability. For example, vegetated foreshores such as salt marshes, mangrove forests and reefs are generally featured by relatively strong temporal and spatial variations in geometry and vegetation characteristics (e.g., stem height, strength, and density), especially under a changing climate, and as a result, their value under extreme storm conditions is uncertain.[19] Such unavoidable uncertainty of working with nature also makes investment returns and the subsequent maintenance costs hard to predict, and thus constrain the investment in NbS. Consequently, although it is widely recognized that NbS can deliver more co-benefits compared to their grey alternatives, there is limited incentive for both public and private actors to consider them during the decision-making process.

Valuing inclusion and diversity while embracing uncertainty for promoting NbS

How to tackle the multiple challenges and enable and mainstream NbS for climate, nature and people has increasingly become a key priority for research. Existing studies have put forward many detailed measures or specific approaches for advancing the uptake of NbS for addressing climate challenges in different levels (such as in Nationally Determined Contributions[20] and in climate adaptation in cities[21]), and for promoting sustainability in general. For example, based on qualitative case studies of six European countries – United Kingdom (UK), Germany, Hungary, Spain, Sweden and the Netherlands – as well as that of the EU as a whole, 20 interventions were identified as pivotal for mainstreaming NbS in urban sustainable development, which include providing a public mandate, generating partnerships, providing economic incentives, improving data and monitoring, advancing valuation models, and growing practitioner expertise.[22] Each of these measures is found to be important for promoting the uptake of NbS, and coordinating them can catalyze wider systemic changes required for embedding NbS in urban regimes such that they reconfigure the flow of power, resources and materials and gain momentum to transform mainstream institutions, infrastructures and social norms to normalize NbS. There is no intention to add new ones here, but to highlight the common cornerstones for these and other pivotal actions for promoting NbS, which are *valuing inclusion and diversity,* and *embracing uncertainty.*

The very notion of NbS is all-inclusive, encompassing various actions that work with nature in different settings for different goals and span over a wide range of temporal and spatial scales, which naturally involve a broad range of actors. Inclusion and diversity thus should not be merely seen as positive outputs of NbS, but rather

18 Cohen-Shacham E, Andrade A, Dalton J, Dudley N, Jones M, Kumar C, Maginnis S, Maynard S, Nelson CR, Renaud FG, Welling R & Walters G (2019). 'Core principles for successfully implementing and upscaling Nature-based Solutions'. *Environmental Science & Policy,* 98, 20-29.

19 Vuik V, Van Vuren S, Borsje BW, van Wesenbeeck BK & Jonkman SN (2018). 'Assessing safety of nature-based flood defenses: Dealing with extremes and uncertainties'. *Coastal engineering,* 139, 47-64.

20 United Nations Development Programme (2019). *Pathway for Increasing Nature-based Solutions in NDCs: A Seven-Step Approach for Enhancing Nationally Determined Contributions through Nature-based Solutions.* New York, USA: UNDP.

21 Wamsler C, Pauleit S, Zölch T, Schetke S, Mascarenhas A (2017) 'Mainstreaming Nature-Based Solutions for Climate Change Adaptation in Urban Governance and Planning'. In: Kabisch N., Korn H., Stadler J., Bonn A. (eds.) *Nature-Based Solutions to Climate Change Adaptation in Urban Areas. Theory and Practice of Urban Sustainability Transitions.* Springer, Cham. https://doi.org/10.1007/978-3-319-56091-5_15.

22 Xie L, Bulkeley B, van der Jagt A, Toxopeus H, Tozer L, Pearl-Martinez R, Dorst H & Runhaar H (2020). *Pathways for Systemic Integration of Nature-based Solutions.* NATURVATION. Deliverable 5.10.

essential elements for their effectiveness and sustainability. Valuing inclusion and diversity involves acknowledging different values, beliefs, knowledge, and experiences towards nature; empowering and engaging different actors (especially those marginalized groups) in decision-making and actions;[23] creating spaces for voluntarism and stewardship; and facilitating dialogues and collaborations across different sectors, expertise, and communities. Opening up spaces for framing, shaping, leading and practicing NbS is also critical for mobilizing different social and ethnic groups to contribute to building and monitoring NbS, for recognizing the trade-offs involved (and thus reducing them to the minimum), for creating and maximizing synergies, and for ensuring and promoting equity. Increasingly, indigenous peoples and local communities (IPLCs) are recognized for their important role in addressing climate and biodiversity crises. Although comprising less than 5% of the world's population, IPLCs protect over 80% of biodiversity in areas that store at least 24% of the total carbon in global tropical forests.[24] Despite the relatively recent use of the term in modern-day science, NbS have been utilized by IPLCs across the world for centuries to protect their local environments. To maintain IPLC's contribution in NbS is thus critical, and requires full respect for their rights and knowledge, and engaging them in relevant policy-making, preventing perverse intervention outcomes on them.

Besides diversity and inclusivity, uncertainty is another underlying feature of NbS. The friction between the lack of certainty of NbS and the need to be certain for traditional policy- and plan- making (especially for investment analysis and goal setting) can lead to difficulties and delays with NbS development and mainstreaming. Whilst building the capacity to reduce uncertainty (by, for example, advancing valuation models) of NbS could to some extent remedy this, embracing uncertainty can turn it into an advantage and thus unleash the great potentials of NbS. Embracing uncertainty means recognizing that NbS are dynamic complex, so their development is not a one-off action but a rolling process of "learning by doing". Instead of formalized, certain and regulated means, implementing and governing NbS require adaptative thinking and management, which includes "devising flexible ways to maximize learning opportunities by applying different strategies, and the consideration of practices as experiments by ensuring that management treatments are replicated and responses are carefully monitored".[25] In other words, to develop and sustain NbS requires flexibility of approach that attends to specific contexts, effective monitoring and long-term maintenance, and timely adjustment in response to changes (social and ecological). Building on inclusion and diversity, embracing uncertainty also welcomes and facilitates creativity and innovations in doing, financing and regulating, which further enables the development of knowledge through practices and the translation of scientific and generic information into locally embedded knowledge the meets the needs of communities and stakeholders, generating broader social, economic and environmental benefits.

23 Pauleit S, Zölch T, Hansen R, Randrup TB, and van den Bosch CK (2017). "Nature-based solutions and climate change–four shades of green," in *Nature-Based Solutions to Climate Change Adaptation in Urban Areas: Linkages Between Science, Policy and Practice,* eds. N Kabisch, H Korn, J Stadler, A Bonn (Berlin: Springer), 29–49. doi: 10.1007/978-3-319-56091-5_3.

24 IUCN (2019) IUCN Director General's Statement on International Day of the World's Indigenous Peoples 2019. https://www.iucn.org/news/secretariat/201908/iucn-director-generals-statement-international-day-worlds-indigenous-peoples-2019.

25 Nesshöver C, Assmuth T, Irvine KN, Rusch GM, Waylen KA, Delbaere B, ... & Wittmer H (2017). 'The science, policy and practice of nature-based solutions: An interdisciplinary perspective'. *Science of the total environment,* 579, 1215-1227.

Not a silver bullet

Sections above have discussed the multiple benefits of NbS, the entrenched challenges that impede their implementation and mainstreaming, as well as the fundamental principles for promoting their effective and sustainable practices. Whilst the efforts to advance their wider uptake continue, it is also important to note that NbS are *not* a silver bullet for all societal challenges. For example, although NbS can increase social inclusion by engaging local communities from the beginning to work with nature,[26] it doesn't mean that changing the political, socio-economic, and cultural roots for social exclusion and discrimination are no longer needed. Similarly, whilst conserving and restoring habitats and species are important for protecting biodiversity, policies and actions that address the indirect drivers of biodiversity loss, such as the unsustainable production and consumption patterns, are also vital to make sufficient progress on fixing the biodiversity crisis.[27]

Acting on climate change is not different. NbS can play a crucial role in meeting reduced emission targets and environmental goals by capturing and storing GHGs through the protection and enhancement of naturally occurring ecosystem. Nevertheless, NbS are neither a quick fix nor a foolproof solution. The sequestration of GHGs by NbS takes place over long timescales,[28] and their effectiveness is sustained only for as long as they remain permanent carbon sinks. For example, carbon stored in forests, wetlands and grasslands risks being released back into the atmosphere due to fires in years to come, especially as the heating-up planet has been driving huge increases in the risk and extents of wildfires.[29] Meanwhile, whilst it is estimated that cost-effective NbS could contribute about 20% of the mitigation needed by 2050 to keep global warming below 2°C,[30] the other 80% will have to come from emissions reductions in the energy, transportation, building, and industrial sectors and, perhaps, from other approaches to carbon removal. Moreover, whilst recognizing the powerful role NbS can play in limiting global warming in the long term, it is important to avoid abusing the concept of NbS to mask continuous emission production and thus slowing global progress towards net-zero, especially when there is an increasing number of high emitting industries making pledges to invest in and implement natural climate solutions to offset their GHG emissions and to reach their net zero emissions targets.[31]

The latest IPCC report makes it clear: to avoid the worst climate impacts, rapid, far-reaching, and unprecedented changes in all aspects of society are required.[32] In other words, besides investing now on NbS to protect, manage and restore ecosystems and land for the future, other methods from rapid decarbonization to geological storage of carbon dioxide and potentially engineering approaches of carbon removal are necessary. Meanwhile, NbS must be designed for longevity, emphasizing synergies among climate benefits and contributions to biodiversity, social inclusion, economic regeneration and other sustainable development goals. Standing at a critical juncture, where global carbon emissions continue to rise and climate and biodiversity predictions grow more dire, every action that can make a difference needs to be taken.

26 Munang R, Andrews J, Alverson K, Mebratu D. (2014) 'Harnessing ecosystem-based adaptation to address the social dimensions of climate change'. *Environ. Sci. Policy Sustain. Dev.* 56, 18–24.

27 IPBES (2019): *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673.

28 Girardin CA, Jenkins S, Seddon N, Allen M, ... & Malhi Y (2021). 'Nature-based solutions can help cool the planet—if we act now.' *Nature.*

29 Stephens SL, Agee JK, Fule PZ, North MP, Romme WH, Swetnam TW, & Turner MG. (2013). 'Managing forests and fire in changing climates'. *Science,* 342(6154), 41-42.

30 Griscom BW, Adams J, Ellis PW, Houghton RA, Lomax G, Miteva DA, ... & Fargione J (2017). 'Natural climate solutions'. *Proceedings of the National Academy of Sciences,* 114(44), 11645-11650.

31 Seddon N, Smith A, Smith P, Key I, Chausson A, Girardin C, ... & Turner B (2021). 'Getting the message right on nature based solutions to climate change'. *Global change biology, 27*(8), 1518-1546.

32 IPCC (2021) *Climate Change 2021: The Physical Science Basis.* IPCC Sixth Assessment Report. Available at: https://www.ipcc.ch/report/ar6/wg1/

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