NATURE-BASED SOLUTIONS FOR CLIMATE CHANGE, PEOPLE AND BIODIVERSITY

I. KEY MESSAGES

1. **Nature-based solutions (NbS) are solutions to societal challenges** that involve working with nature to deliver benefits for both people and biodiversity. They include protecting existing ecosystems, restoring and connecting previously degraded ecosystems, managing working lands more sustainably, and creating novel habitats such as urban green infrastructure. The key strength of NbS is that, if well designed and robustly implemented, they can deliver multiple benefits for climate change mitigation and adaptation, enhance biodiversity, promote human wellbeing and support the economic recovery.
2. **Investments in NbS should meet** high-level guidelines: (a) NbS are not an alternative to decarbonising the economy and must be accompanied by swift, deep emissions cuts; (b) they should encompass protection, restoration and sustainable management of a wide range of ecosystems on land and in the sea; (c) they must be designed with and for local communities; and (d) they must deliver measurable benefits for biodiversity and be designed to be resilient to climate change.
3. **The UK should implement NbS in a wide range of semi-natural ecosystems** which are important for protecting people and infrastructure from the impacts of climate change while also reducing net greenhouse gas emissions and benefitting biodiversity. NbS can contribute significantly to achieving net zero emissions, although the extent of that contribution is limited by the finite amount of land available and critically by the effects of climate change on ecosystems.
4. **In the UK, scaling up restoration and protection of key ecosystems requires** (a) better protection of natural habitats in the planning system; (b) reforming agriculture and forestry subsidies to better support actions that benefit both climate regulation and biodiversity; (c) connecting habitats across landscapes, building on the emerging Nature Recovery Networks; (d) making it compulsory to build an NbS framework into all new developments, and (e) making space on land for natural systems to adapt to climate change.
5. **There is a need to develop robust metrics** to assess the effectiveness of a wide range of NbS for carbon sequestration, water regulation, storm and erosion resistance, biodiversity and human wellbeing. This will help to align thinking between the Intergovernmental Panel on Climate Change and Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
6. **On land, commercial forestry using non-native species is necessary** for the production of timber and woody biomass, but may not deliver significant climate change mitigation benefits, and there is a risk that the current global focus on forestry as a silver-bullet climate solution will deliver poor outcomes for biodiversity and local people, and only limited benefits for climate mitigation and adaptation.
7. **Well-designed new financing mechanisms,** including tax incentives and public subsidies for ecosystem stewardship that meet the NbS guidelines and support climate change mitigation, climate change adaptation and biodiversity, could be instrumental for upscaling NbS and improving social-ecological resilience to climate change, both in the UK and globally.

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2. CONTEXT

The UK and the international community face the triple challenge of averting dangerous climate change, preventing the collapse of global biodiversity and promoting human wellbeing. In recognition of this, there have been calls to end siloed thinking and address interrelated ecological and societal challenges in an integrated and coherent way (e.g. the Leaders' Pledge for Nature). Nature-based solutions (NbS) are solutions to societal challenges that involve working with nature to deliver benefits for both people and biodiversity[1] and have the potential to deliver synergistic benefits across all three domains. NbS will be prominent in COP26 negotiations, as 131 nations have already included them in their Nationally Determined Contributions[2].

NbS can deliver benefits for both climate change **mitigation**, especially by enhancing carbon storage, and for **adaptation**, by reducing communities' exposure and sensitivity to the negative consequences of climate change and by enhancing their capacity to adapt to such change[3]. There are many examples of successful projects (see Oppla, the Connecting Nature Enterprise Platform, Engineering with Nature, The Endangered Landscapes Programme). NbS encompass the **protection** of existing habitats, the **restoration** of ecosystems that have been degraded, the **sustainable management** of working land and aquatic systems and the **creation** of novel ecosystems[4,5]. The protection of existing habitats prevents the further release of greenhouse gases through land conversion in terrestrial systems, and reduction of seabed activity in the marine realm, safeguarding the biodiversity that depends on such habitats, as well as the wider ecosystem services they provide. The restoration of degraded habitats can actively improve the ability of natural systems to remove greenhouse gases from the atmosphere, as well as recover biodiversity and ecosystem services. By improving the management of productive landscapes, mitigation can be achieved by the enhancement of carbon storage and the reduction of emissions (e.g. increasing organic matter in farmland soils). Finally, the creation of novel habitats, sometimes called 'green engineering' on land or green infrastructure in our cities, can also help society adapt to the adverse effects of climate change, for example by naturally cooling (and in some cases cleaning) air and bringing mental and physical health benefits.

3. FOUR GUIDELINES FOR SUCCESSFUL, SUSTAINABLE NBS

The benefits of NbS can only be delivered if programmes are designed and implemented following best practice guidelines (NbS Guidelines[6]):

1. NbS can never be a substitute for the urgent task of decarbonising all sectors of the economy. Modelling suggests that even under ambitious scenarios, land-use options could only contribute around 9% of the UK's emissions reduction target by 2030[7]. Thus, the main mitigation priority is immediate and stringent cuts in fossil fuel emissions across all sectors. Alongside this, NbS have a key role to play in an economically efficient portfolio of climate mitigation and adaptation actions, but offsetting emissions with NbS should only be accepted if ambitious and credible decarbonisation plans are set. Otherwise there is a risk that NbS could be used to justify the continuation of 'business as usual' for high-emitting activities, such as in recent campaigns that encourage people to 'drive carbon neutral' on the grounds that NbS are being used to offset emissions.
2. The world's remaining intact ecosystems and biomes are hotspots for both biodiversity and carbon storage, while also protecting people from climate change impacts. Yet many of these areas lack effective protection or are poorly managed. Degradation of ecosystems significantly reduces carbon storage and sequestration and increases vulnerability to climate-related hazards such as fire. The multiple benefits of NbS can be optimised by using a landscape approach that encompasses protection, restoration and sustainable management of a wide range of ecosystems and their dynamics on land and in the sea, tailored to their local geography. To implement this, transformative changes in policy, land use planning and financial instruments for NbS are urgently required that work at the landscape scale.
3. NbS should be managed by, or in partnership with, local communities through a process that champions their rights and knowledge, supports livelihoods, and reduces vulnerability to climate change. Only by explicitly involving local communities can the legitimacy and long-term stewardship of NbS be secured[8]. Land ownership and governance will affect the outcomes of NbS, as well as their perceived legitimacy. The Paris Agreement acknowledges that equity and human rights are essential to climate action. This is especially the case in low-income countries, where NbS to protect carbon sinks and biodiversity may lead to increased poverty and restrictions in access to resources by vulnerable groups, including indigenous people IPCC Special Report on Climate Change and Land, 2021.

4. NbS should be designed to deliver measurable benefits for biodiversity and ecosystem health. For example, sensitive regeneration of native woodland on farmland can deliver major benefits for biodiversity, but afforestation with non-native monocultures could achieve little or no benefit (unless the previous habitat was severely degraded), and may even cause losses of species-rich grassland, heathland or peatland. Where possible, NbS should be designed to be resilient to climate change, which affects ecosystem health and therefore carbon sequestration and storage[9]. Regardless of the rate of future decarbonisation, current GHG levels in the atmosphere have already locked in a degree of climate change that will affect the effectiveness of NbS in the near future. Understanding these vulnerabilities, and identifying where climate resilient areas exist, are vital when investing in NbS. In coastal areas, for example, planners and landowners need to make space for habitats such as dunes and saltmarshes to migrate inland in response to sea level rise and erosion[10,11]. Long-term protection and management is needed to ensure the durability of NbS climate and biodiversity benefits, without precluding the sustainable harvesting of resources[10,11].

4. NBS IN THE UK

NbS can support job creation and livelihoods, and can play a key role in "building back better" after COVID (COP26 Universities Briefing paper) if supported by government. The potential of the UK's peatlands, woodlands, grasslands, freshwater systems, coastal marine systems, arable landscapes, heathlands and urban green spaces to act as NbS has been evaluated by the British Ecological Society, with input from over 100 academics and some contributions from statutory agencies and NGOs (reports launched on 12th May 2021)[12]. They find that NbS are generally more cost-effective to deploy than non-NbS approaches to both mitigation and adaptation, they are hugely valuable when it comes to avoided damages from extreme events, and they can support short term economic recovery.

On land, the restoration of peatland, protection of native woodland and expansion of upland forests on mineral soils would absorb atmospheric carbon, regulate water flows across the catchment and promote biodiversity. Protecting existing terrestrial carbon stocks could secure 16,231 Megatonnes of CO_2 equivalent (Mt CO_2e), and an additional climate change mitigation of 75-123 Mt CO_2e by 2030 and 278-492 Mt CO_2e by 2050 could be achieved through restoration of degraded peatlands and creating new woodland[1]. (See also Figure 1).

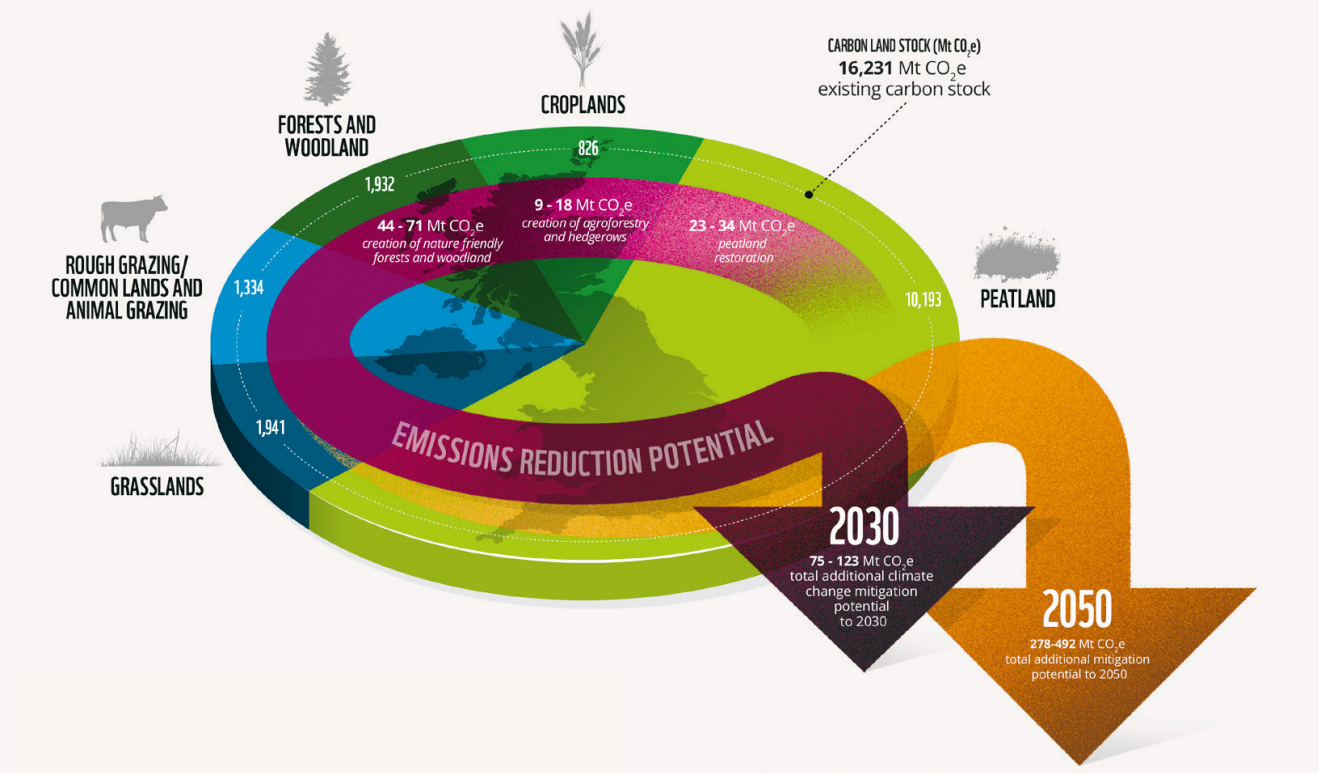

Figure 1: Emissions reduction potential of NbS in the UK, taken from WWF/RSPB 2020, over the next 10 and 40 years. By comparison, UK emissions in 2019 were 433 Mt CO_2e per year, of which 81% was CO_2.

In addition, the UK's coastal habitats and continental shelf store at least 71,000 Mt CO_2e[13,14]. There may be significant potential for the UK (including its overseas territories) to enhance the carbon stored in vegetation and sediment by re-establishing lost saltmarshes and seagrasses[15] and by jointly managing seaweed and shelf sediments[13,16]. Management interventions for these systems do not fit current blue carbon policy frameworks[17].

NbS also offer a range of opportunities for climate change adaptation within the UK if long-term investments are made. The deployment of 'green engineering' can serve as an alternative or complement to other infrastructure developments. For instance, the restoration and protection of coastal habitats (including saltmarshes, dunes and reefs) can reduce the risk of coastal flooding caused by sea-level rise where sedimentation rates are sufficiently high (e.g.[18], Scotland's dynamic coast). Importantly, these strategies may simultaneously deliver mitigation benefits, where enhancing the capacity of coastal habitats to respond to sea level rise also leads to enhanced storage of carbon while avoiding CO_2 emissions associated with engineering solutions. NbS are not quick-fixes; rather, they aim to bring about long-term changes and sustainable solutions in the ways in which natural capital is managed and used, by making appropriate long-term investments.

All of the UK's land- and seascapes are actively managed, or have been in the past, leaving us with a mosaic of semi-natural habitats that continue to provide valuable ecosystem services and support biodiversity. Even these semi-natural habitats are under pressure due to competing demands for food, timber, biofuels, housing and infrastructure development, fisheries, deep sea mining and offshore electricity generation, among others. A strategic approach is needed to balance trade-offs between these uses and to provide space for nature and the services it provides. The UK government's 25-year Environment Plan offers a chance to create bigger, better, more joined up networks of nature.

There are certainly examples of NbS that deliver multiple benefits with few downsides. Restoring coastal wetlands or restoring degraded upland peat, for example, can help to protect communities from flooding or erosion while also storing carbon, providing recreational space and natural habitat for wildlife with negligible loss of agricultural potential on the national scale. However, NbS that require land use change are more likely to involve trade-offs. In particular, implementing government plans to establish an additional 30,000 ha of woodlands per year by 2025 needs to establish the right trees in the right places[19]:

- While there are many opportunities to establish new native woodlands to create bigger, better-connected nature networks, sequester carbon and improve human well-being, the 'rough grazing land' often targeted for afforestation[20] may include carbon and species-rich native grasslands, heathland or peatland where even native woodland may lead to losses of carbon and biodiversity.
- Establishing woodland on high-quality arable land is problematic, as it increases the UK's reliance on food imports which could accelerate tropical deforestation to meet global demand, unless crop productivity is improved[7].Even native woodland plantings on low-productivity grazing land are unlikely to deliver lasting climate benefits unless we consume less animal-sourced food or intensify production elsewhere. Without behavioural change, shifts in land use in the UK could lead indirectly to deforestation in the tropics.
- Commercial forestry using non-native species is necessary for the production of timber but may not deliver significant climate change mitigation benefits if planted on peat, and delivers poor outcomes for biodiversity compared to planting native woodlands. The UK Forestry Standard that governs the industry may need further refinement to ensure multiple services are adequately delivered.
- Native woodland could be planted in upper catchments to reduce downstream flooding and store carbon, but lower in the catchment it might be more appropriate to restore floodplain meadows by breaching river embankments, to provide flood storage capacity and enhance pollinator habitat while maintaining productive use of grazing land.

With growing pressure from urban and infrastructure development, it is vital that planning policy is strengthened to avoid loss of good quality agricultural land, and other natural capital assets, including carbon and biodiversity-rich grasslands, woodlands, peatlands, wetlands, and coastal and marine habitats. Planning policy also needs to prioritise spatially targeted NbS in strategic and local plans, including making space for NbS to adapt in response to climate change[11]. There is a window of opportunity now to make planning decisions that can safeguard space on land and the marine environment[11,21] to give future generations the greatest flexibility in their adaptation choices, and to avoid lock-ins (e.g. development in zones of future risk) that limit options for NbS. Recent legislation in Wales is providing good exemplars for requiring NbS in flood risk policy (Welsh Government, 2020) and for requiring the needs of future generations to be considered when making planning and infrastructure decisions now, using a joined up approach.

A barrier to scaling up NbS is availability of finance. Sources include philanthropy, voluntary carbon offsetting, public sector grants, agri-environment schemes, payment for ecosystem services (such as water companies paying farmers to reduce pollution runoff), or regulatory obligations for firms to offset the impacts of their actions, such as biodiversity offset markets arising from net gain requirements[22]. Landowners need incentives to cover the opportunity costs of restoration activities, as well as direct investment costs. NbS can be made more investable by stacking multiple benefits for climate, biodiversity and other services such as flood protection or water quality, financed by different beneficiaries and supported by a greater range of multi-sectoral legislative or policy instruments. Opportunities for blended public and private finance are being explored, for example with governments underwriting the risk for private sector investors.

5. UK CONTRIBUTIONS IN INTERNATIONAL COOPERATION AND CLIMATE POLICY

There is scope to use strategic UK investments in NbS to enhance the UK's Global Britain vision and contribute to a successful UK COP26 presidency. These could also build on UK science successes to highlight the role of the UK's world-leading science base in this area. Pledges by governments and businesses to use NbS for climate change mitigation largely focus on tree planting initiatives, e.g. via the Bonn Challenge. However, an estimated 45% of the Bonn Challenge pledges in tropical regions are for commercial plantations and 21% for agroforestry, which have low or adverse biodiversity impacts and low carbon benefits compared to restoring natural forests[23]. Policies need to support a much wider range of NbS than tree planting, by restoring and connecting a mix of native ecosystems. In the marine environment, there are opportunities to integrate protection and restoration of coastal wetlands and seagrasses into Nationally Determined Contributions (NDCs)[24]. Strong governance is essential, to ensure projects meet UN Sustainable Development Goals. As host of COP26, the UK can play a key role in forging links between the UNFCCC and the Convention on Biological Diversity COP15 conference in October 2021, to deliver benefits for both biodiversity and carbon, and avoid adverse outcomes. The FACT Dialogue launched by the UK COP Presidency in February 2021 provides an opportunity for the UK to promote NbS.

Avoiding the conversion of tropical forests into grassland, arable land, shrimp farms or commercial plantations is one of the most cost-effective emissions reduction strategies worldwide, with the greatest biodiversity benefit. In this context, investments have been effective in countries and regions where there are large expanses of intact old growth forests and currently small amounts of deforestation[25], but there is a need to develop new incentives for these "high forest, low deforestation countries and regions" to understand the NbS provided by the forests and to keep these forests standing. Much tropical deforestation is illegal, hence enabling the enforcement of existing legislation is needed. A better control of supply chains would be beneficial in this regard, especially to control the trade of timber from illegal deforestation.

Lessons need to be learnt from a decade of REDD+ programmes, which have sought to fund the protection and/or restoration of natural tropical forests through international carbon trading to offset emissions in wealthy countries[26]. While initiatives such as REDD+ have the potential to deliver multiple benefits, the following concerns have been raised:

- that carbon 'credits' associated with natural processes – like forest recovery – may be used to delay or avoid action to reduce emissions in other sectors, and thus undermine the integrity of countries' accounts of anthropogenic emissions and removals[27].
- that carbon stored in terrestrial ecosystems may be released back to the atmosphere due to natural or anthropogenic disturbances (e.g. fires, storms, diseases, harvesting, etc. which are becoming more frequent as the climate warms), endangering the permanence of the sink.
- that projects may be successful within the region protected, but might displace forest degradation activities elsewhere because the fundamental demand for resources remains unchanged.
- that REDD+ has been associated with notorious cases of 'land grabbing' where regulatory frameworks are weak that have displaced or disenfranchised indigenous peoples in order to secure forest carbon benefits.

More generally, the uptake of mitigation related to land use and forestry has been slower than for similar initiatives in the energy sector because of the regulatory challenges[28].

Article 6 of the Paris Agreement recognizes that Parties may choose to cooperate in the implementation of mitigation activities but the rules for cooperation remain under negotiation.

While protecting and restoring native vegetation in the tropics remains a potentially cost-effective overseas investment for UK mitigation and adaptation plans, great care must be taken to ensure that investments are additional to domestic actions, and that cooperation promotes 'sustainable development and ensure environmental integrity and transparency, including in governance', and applies 'robust accounting' to ensure the avoidance of double counting. The Paris Agreement established a new 'mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development' which should build on the 'experience gained with and lessons learned from existing mechanisms', among other things.

6. POLICY RECOMMENDATIONS

Delivering NbS for climate, biodiversity and human wellbeing within the UK

1. The UK has an opportunity to use COP26 to promote the global adoption of good practice principles for NbS.
2. The UK's adaptation strategy and NDC policies should link ambitious initiatives that support uptake of NbS with strong monitoring, reporting and verification systems. This could be linked to a "carbon farming" certification system to encourage farmers to store carbon in soils or vegetation, and environmental and human rights due-diligence legislation with extraterritorial implications.
3. Existing carbon-rich and biodiverse habitats need better protection in the planning system by closing loopholes that allow destruction of woodlands, hedgerows, semi-natural grasslands, heathlands, wetlands, peatlands and saltmarshes for housing and infrastructure development.
4. Projects that destroy existing biodiverse and/or carbon-rich habitats should not be supported. This would exclude support for planting monocultures of non-native species, or for planting trees on biodiverse semi-natural grassland, and would extend the current ban on planting forests on deep peat to include shallower peat soils. Development should be avoided in places in which NbS could protect against flooding and storm damage.
5. NbS should be mandatory in all housing, development and infrastructure projects, including sustainable drainage systems (following Scotland's existing legislation) and other urban greening measures, as well as providing space for NbS to adapt to climate change, such as through coastal and river dynamics[10].

Strategic planning at landscape scale

6. Policy support should encourage planning of a diverse mix of NbS options at landscape scale, including restoration of semi-natural grassland, floodplain meadows, coastal habitats and natural regeneration of mixed habitat mosaics.
7. A modest amount of core funding for Local Nature Partnerships would enable them to lead on landscape level planning and ensure that NbS are designed to complement Nature Recovery Networks and strategies.
8. There should be support for land-based policies that encourage strategic and local development plans to take greater account of predicted changes in flood and erosion risks from rivers and coasts, and to safeguard space on land for NbS (e.g Clyde Marine Plan).
9. Innovative multi-scale and multi-sector governance mechanisms to support provision of NbS at the landscape scale would help overcome known governance challenges and accelerate implementation of NbS, such as the CCC report on coast in a changing climate.

Economic incentives

10. Mechanisms are needed to ensure that polluting industries reduce their emissions as quickly as possible, and only offset unavoidable emissions. Failure to do this would put the achievement of climate targets at risk because the NbS may not be fully additional.
11. Grants and subsidy schemes should ensure that NbS are explicitly designed to deliver measurable benefits for biodiversity and multiple ecosystem services in addition to carbon sequestration.
12. Economic incentives should be designed to enhance spatial coordination across landscapes (e.g. via Tier 3 of the Environmental Land Management scheme, Catchment Management partnerships or Landscape Enterprise Networks). Potential incentive mechanisms to achieve such spatial coordination include the Agglomeration Bonus[29].
13. The design of incentive schemes should prioritise the participation of landowners for whom NbS pose low costs and yield high social benefits, for example through the wider use of conservation auctions[30].
14. Governance, monitoring and verification is needed in voluntary carbon markets, and should be independent of buyers, registries, project developers and verifiers, to ensure the environmental and social integrity of carbon credits that are traded to ensure actual emissions reductions occur.

Metrics and monitoring

15. Criteria are needed to establish whether companies are doing enough to reduce their fossil fuel emissions before they claim credits for offsetting residual emissions via NbS.
16. Metrics are needed for predicting likely climate, biodiversity and socioeconomic benefits. Carbon metrics cover only woodland creation (e.g. the UK Woodland Carbon Code) and peatland restoration (IUCN UK Peatland Code). Research is urgently needed to compile better data on carbon storage and sequestration in non-forest habitats: grasslands, wetlands, scrub and heath, as well as marine and coastal habitats and urban green infrastructure. A wider range of tree-related metrics is also needed, including different types of agroforestry, street trees, field trees, hedgerow creation, and natural regeneration as well as active planting of trees. Better methods of assessing the impacts of policies on these impacts are also needed[31].
17. Funds need to be made available for monitoring of existing and planned NbS, especially monitoring biodiversity impact by tracking the abundance of key species before and after projects are implemented.

Involving communities

18. Participatory approaches with landowners and other stakeholders are vital to ensure the legitimacy, equity and effectiveness of NbS to meet local needs. There is a need to foster discussions that support identification and testing of creative, transformative and even disruptive mechanisms that support NbS, transform governance and financial systems and increase societal willingness to use NbS as a tool to boost social-ecological resilience.

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