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DEVELOPING NATURE-BASED SOLUTIONS TO CLIMATE CHANGE: LEGAL CHALLENGES AND EMERGING SOLUTIONS

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The idea of nature-based solutions (NbS) to climate change has gained significant attention and support in recent years. These solutions focus on using natural ecosystems and processes to mitigate and adapt to the impacts of climate change, such as reforestation, wetland restoration, and sustainable agriculture practices. However, the implementation of nature-based solutions faces several legal, policy, and the administrative challenges of coordinating. These challenges include the need for clear and consistent regulations, the allocation of rights and responsibilities, the integration of nature-based solutions into existing legal frameworks. This paper adopted the approach of analyzing case studies from different countries to identify the key legal and policy barriers that hinder the widespread adoption of nature-based solutions. The findings revealed that one of the main challenges is the lack of coordination among different government agencies responsible for implementing nature-based solutions. This often leads to conflicting regulations and a lack of clarity on the roles and responsibilities of each agency. The paper highlights the need for stronger legal frameworks that prioritize and incentivize nature-based solutions, as well as the importance of engaging local communities and stakeholders in the decision-making process to ensure successful implementation.

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1. INTRODUCTION

"Nature-based Solutions" (NbS) have gained popularity in the last several years as the go-to strategy for dealing with pressing environmental and social issues.[1] Although NbS has been proposed for several applications, such as reforestation, community protection, soil erosion, and landslides, the concept's appeal is mostly due to two issues: climate change and land degradation. Regarding the first, the build-up of greenhouse gases, such as carbon dioxide, in the atmosphere is causing the globe to warm at rates not seen in the geological record.[2] It becomes necessary to take action to mitigate and adapt to the effects of climate change.

The second issue is that biological diversity is vanishing due to human activity on the earth.[3]It is possible that current losses are getting close to rates seen in the fossil record during a select few apocalyptic occurrences.[4] While the loss of natural ecosystems that support varied species of creatures is frequently pointed out as the bigger cause, climate change is also linked to the decline in biodiversity. Therefore, strategies that would reduce the effects of climate change and help humans adapt to them by protecting natural systems and the diversity they support are essential and urgent.[5] It will be important at this point to give a brief explanation of nature-based solutions.

NbS are measures taken to maintain, sustainably manage or restore natural or modified ecosystems to address societal concerns while benefiting both people and the environment.[6] It promotes the balance. These solutions frequently rely on long-standing conservation practices created in the struggle against natural loss, including but not limited to climatological changes. It can also become necessary due to unsustainable practices such as fishing, deforestation, and waste disposal. Protection or conservation of natural areas, reforestation, restoration of marshes or other ecosystems, or sustainable management of farms, fisheries, forests, or other resources. All these are examples of possible solutions. NbS can be used anywhere: in rural forests and

[1] E Cohen-Shacham and others (eds), *Nature-based Solutions to Address Global Societal Challenges* (IUCN International Union for Conservation of Nature 2016).

[2] Intergovernmental Panel on Climate Change, *AR6 Climate Change 2022: Mitigation of Climate Change* https://www.ipcc.ch/report/ar6/wg3 accessed 7 April 2022.

[3] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, *Global Assessment Report on Biodiversity and Ecosystem Services* https://ipbes.net/global-assessment accessed 15 November 2023.

[4] John P Rafferty, 'Biodiversity Loss' (Encyclopaedia Britannica, 23 January 2024) https://www.britannica.com/science/biodiversity-loss

[5] David Simpson, 'Economics of Nature-Based Solutions: Current Status and Future Priorities' (United Nations Environment Programme 2020) 9.

[6] Federal agencies use various terms and recognize various definitions (see Appendix). Other terms include green infrastructure, natural and nature-based features, natural climate solutions, and natural infrastructure. For the purposes of this report, we use the term nature-based solutions as inclusive of all of these terms

farmlands, developing metropolitan areas, coastal and ocean areas, around sensitive infrastructure, and in historically under-represented populations. Implementing nature-based solutions not only helps to preserve and restore biodiversity but also provides numerous socio-economic benefits.

The main definitions of NbS in use are: UNEA-5 resolution as 'actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits;[7] and the one from the International Union for Conservation of Nature - IUCN that defines NBS 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".[8]

The European Commission defines them 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"[9]

NbS can contribute to addressing seven societal challenges: 1. climate change mitigation and adaptation; 2. disaster risk reduction; 3. economic and social development; 4. human health; 5. food security; 6. water security; and 7 reversing environmental degradation and biodiversity loss.[10] The Organisation for Economic Cooperation and Development proposes a definition that NbS are measures that protect, sustainably manage or restore nature, to maintain or enhance ecosystem services to address a range of social, environmental and economic challenges.[11]

Nature contributes both positively and negatively to human well-being. Positive contributions include food supply, water purification, flood control, and artistic inspiration. Negative contributions include disease transmission and predation that can harm people or their property. Depending on cultural, temporal, or spatial

[7] UNEP UNEP, 'Ministerial Declaration: UNEA-5' (Environment Assembly, 2022) accessed 8 February 2024

[8] International Union for Conservation of Nature (IUCN), *IUCN Global Standard for Nature-based Solutions: A User-Friendly Framework for the Verification, Design and Scaling Up of NbS: First Edition* (1st edn, IUCN 2020).

[9] European Commission, 'Nature-Based Solutions' https://commission.europa.eu/topics/research-innovation/nature-based-solutions_en accessed 31 March 2024.

[10] T Dunlop and others, 'The Evolution and Future of Research on Nature-Based Solutions to Address Societal Challenges' (2024) 5(1) Communications Earth & Environment 1.

[11] OCDE. Performance of the SDG identification algorithm. Disponível em: . Acesso em: 17 dez. 2022.

contexts, nature can be perceived either as beneficial or detrimental. Therefore, NbS can have a broad meaning in different contexts.[12] But not here.

The purpose of this paper is limited to climate, we will explore the legal and policy challenges in developing NbS to climate change and to propose potential strategies for overcoming these challenges. NbS, such as reforestation and ecosystem restoration, have the potential to mitigate climate change by sequestering carbon dioxide and enhancing natural resilience to extreme weather events. However, implementing these solutions requires a comprehensive legal and policy framework that addresses issues such as land ownership, funding mechanisms, and regulatory barriers. By analyzing case studies, existing laws, and policies, this paper aims to identify key challenges to provide recommendations helping policymakers to effectively develop and implement NbS for climate change mitigation in a large scale.

This paper is thus constructed to provide a thorough examination of NbS to climate change. The introduction section examines the fundamental concepts of NbS, emphasising its importance and scope in tackling environmental concerns. The section on NbS Examples shows actual implementations in a variety of scenarios, demonstrating its versatility and efficacy. The next chapter discusses the advantages of NbS, focusing on their environmental, social, and economic benefits such as carbon sequestration and biodiversity enhancement. The next section looks at the philosophical, regulatory, and practical challenges to their widespread implementation. Finally, the paper delves into the legal, policy, and governance frameworks required for expanding NbS, emphasizing the importance of international collaboration and strategic thinking in realizing their full potential. Together, these sections attempt to provide actionable insights and assistance to stakeholders and decision-makers.

2. NATURE-BASED SOLUTIONS (NbS) EXAMPLES

Actions motivated by, bolstered by, or imitating nature, are known as nature-based solutions,[13] are intended to assist communities in finding sustainable solutions to a range of environmental, social, and economic problems. Most NbS seek to provide several co-benefits rather than just one main goal.

The idea first gained momentum at 2000s to support using nature as a source of answers to problems related to climate change. The European Commission

[12] IPBES, I. S.-P. P. ON B. AND E. S. Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. [s.l: s.n.]. Disponível em: . Acesso em: 15 nov. 2023.

[13] D Bourguignon, *Nature-Based Solutions: Concept, Opportunities and Challenge.*

and the International Union for the Conservation of Nature have both backed and expanded it.[14]

There are several overlapping types as following:

- Type 1 involves minimal intervention to maintain or enhance the provision of ecosystem services, both within the protected area and beyond. Examples include protecting mangroves in coastal regions to reduce risks from extreme weather events and benefit local communities and establishing marine protected areas to conserve biodiversity while supporting fisheries beyond their boundaries. This approach is consistent with biosphere reserves, which include core protected areas and sustainable buffer zones where people live and work.[15]

- Type 2 Management of ecosystems to optimise their sustainability and multifunctionality. This can range from extensive to intensive management strategies. Examples include innovative planning of agricultural landscapes to increase their productivity and diversity of services, and strategies to enhance genetic diversity in forests to increase their resilience to environmental stresses.[16] This approach is consistent with concepts such as integrated systems, regenerative agriculture, agroecology, agroforestry.

- Type 3 involves highly intrusive management or the creation of entirely new ecosystems, such as the construction of artificial soils from residues, green roofs or walls in cities to mitigate urban heat and air pollution. This type is closely linked to green and blue infrastructure aimed at restoring severely degraded or polluted areas. It also explores innovative methods such as bridging biodiversity conservation and landscape architecture.[17]

NbS have mainly been covered under the Horizon 2020 framework program for research and innovation in European Union (EU) policy.[18] The program allocated roughly €185 million to the issue between 2014 and 2020.[19] Additional EU funding, expected to be worth €915 million per year, is also allotted to green infrastructure initiatives. The biodiversity strategy, the seventh environment action program, and the communication on green infrastructure are similar policy measures.[20]

[14] Ibid.
[15] H Eggermont and others, 'Nature-Based Solutions: New Influence for Environmental Management and Research in Europe' (2015) 24(4) *GAIA – Ecological Perspectives for Science and Society* 243.
[16] Ibid.
[17] Eggermont (n 15)
[18] Eggermont (n 15)
[19] Deloitte, *A Quick Guide to EU Funding 2014–2020* (2020)
[20] Bourguignon (n 13)

The Table 1 shows examples of NbS. Each problem and each example of an NbS links man and nature. Individual NbS often have multiple benefits. It should also be noted that the table is not an exhaustive list.

Table 1: Examples of nature-based solutions

Problems	Examples of Nature-based solutions
Greenhouse gas emissions	**1. Conserving or restoring coastal habitats, forests, wetlands and grasslands –** removes carbon dioxide from the atmosphere atmosphere and stores it, slowing climate change. **2. Improved agricultural management, including cover crops, no-till, rotational grazing, integrated agricultural systems, and sustainable timber management** - reduces erosion, stores more carbon in soils and vegetation, and requires less fuel through reduced tilling, slowing climate change.
Urban heat island; heat stress; urban air pollution	**1. Green roofs –** help to insulate buildings from high temperatures and cool them through evapotranspiration, reducing cooling needs, costs, and emissions. **2. Urban trees and forests –** capture air pollutants and cool the air, reducing urban heat island effects and heat stress on people and infrastructure and reducing cooling costs and emissions.
Inland flooding; non-point source pollution (e.g., excess nutrients and sediment); and erosion	**1. Floodplain reconnection and restoration –** lowers river height and speed during a flood and reduces erosion, sedimentation, and pollution from excess nutrients. **2. Enhanced water storage in wetlands, forests, or farmland –** reduces runoff and flooding improves groundwater recharge, and decreases erosion, sedimentation, and pollution **3. Protecting or restoring riparian buffers –** slows water, stabilizes banks, and reduces pollution. **4. Sustainably managing forests, farms, and grazing lands –** including sustainable forest management, agroforestry, silvopasture, planting cover crops, diversifying crops, and rotational grazing - can reduce erosion and excess nutrients that cause water pollution.
Stormwater and sewer overflow and costs; urban flooding; water pollution	**1. Green Roofs –** absorb, evaporate, and transpire some water, reducing stormwater runoff and moderating local flooding. **2. Rain Gardens –** in shallow basins in yards and along streets or sidewalks, absorb stormwater runoff. **3. Bioswales –** long, deep channels of plants and grasses along roads and parking lots - absorb runoff and release water slowly. **4. Urban trees and forests –** absorb water, reducing runoff, combined sewer overflow, and urban flooding.

from urban settings	**5. Constructed wetlands –** capture stormwater runoff, and treat wastewater, reducing costs and pollution.
Shoreline erosion; tidal flooding; storm surge	**1. Protecting or restoring coastal habitats –** mangroves, coral reefs, oyster reefs, beaches, rock reefs, coastal dunes, freshwater marshes, and salt marshes all help reduce coastal erosion and, depending on their extent, can reduce flooding from storms and high tides. **2. Living shorelines –** native coastal habitats (oyster reefs, salt marsh, mangroves, seagrass beds) alone or in combination with sills and berms reduce storm surge and coastal erosion and stabilize the shoreline.
Wildfire	**1. Forest management –** carefully managed prescribed burns reduce wildfire severity and community risk. **2. Greenbelts –** forests near communities that are managed to be less flammable or irrigated provide a fire break, reducing fire risks.
Drought	**1. Clearing invasive plants –** that use more water than native species increases available water. **2. Protecting beavers -** changes hydrology and increases groundwater recharge and dry season flows. **3. Water storage on agricultural fields -** Converting unproductive crop areas to meadows or wetlands enhances groundwater recharge while reducing flooding and nutrient pollution.
Crop loss from pests or poor pollination	**1. Planting pollinator habitats** in gardens, along roads, or elsewhere provides food for pollinators, enhances biodiversity, and improves some nearby crop yields. **2. Integrated pest management –** restoring or improving habitat for native pest predators (e.g., bats, birds and snakes) reduces the costs of managing pests on agricultural lands.

Table adapted from the examples mentioned in the report National Academies of Sciences, Engineering, and Medicine.[21]

Building on the diverse examples of nature-based solutions (NbS) illustrated in Table 1, which focus on addressing specific environmental challenges such as greenhouse gas emissions and urban heat islands, Table 2 extends the discussion by delving into integrated agricultural systems. These systems exemplify how NbS can be tailored to optimize land use, combining ecological restoration with agricultural productivity. The

[21] National Academies of Sciences, Engineering, and Medicine, *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda* (National Academies Press 2019).

transition from general NbS applications to detailed agricultural frameworks underscores these solutions' versatility in addressing environmental and socio-economic objectives. This progression highlights the potential for NbS to mitigate climate impacts and enhance food security and rural livelihoods through innovative practices.

Therefore, Table 2 highlights examples of **integrated agricultural systems** that employ **Nature-Based Solutions (NbS)** to enhance sustainability in agriculture while addressing environmental challenges like climate change and soil degradation. These systems, including agroforestry, alley cropping, silvopasture, and agrisilviculture, integrate crops, livestock, and forestry to promote carbon sequestration, improve soil fertility, and reduce erosion. Practices such as planting hedgerows, using natural fallows, and optimizing tree-crop-livestock interactions demonstrate how NbS can mitigate climate impacts by reducing dependence on synthetic inputs and enhancing biodiversity. The dual benefits of these systems are emphasised—boosting agricultural productivity while contributing to ecological restoration and climate resilience.

Table 2: Examples of integrated agricultural systems

Alternatives	Examples of Nature-based solutions
Agroforestry	**Integrated crop-livestock-forest** Reduces erosion, stores more carbon in soils and vegetation, and requires less fuel through reduced tilling, slowing climate change.
Alley cropping systems	**Planting rows of trees at wide spacing with a companion crop grown in the alleyways between the rows** Reduces erosion, stores more carbon in soils and vegetation, and requires less fuel through reduced tilling, slowing climate change.
Improved or natural fallows (shifting cultivation)	**They often consist of fast-growing, preferably leguminous, woody species planted and left to grow for short periods (2–3 years) of fallow between cropping periods for soil fertility enhancement; woody species may yield economic products** reduces de use of fertilizers slowing climate change.
Hedgerows	**These consist of linear plantation around the fields and could serve as fences, boundaries, and even protective system.** reduces de use of chemicals slowing climate change.
Agrisilviculture/ agrosilviculture systems	**This system involves simultaneously growing crops and trees on the same piece of land.** protect the crops reduce the use of chemicals slowing climate change

Silvopasture (wood pasture type)	**This is a form of agroforestry practice that integrates livestock, forage production, and forestry on the same land-management unit** protect the animals, promote one health, capture emissions slowing climate change

Adapted from the examples mentioned in the report Integrated Agricultural Systems.[22]

NbS play an important role in fostering sustainable development by tackling environmental, social, and economic concerns in a holistic manner.[23] These solutions directly contribute to various UN Sustainable Development Goals, emphasizing their diverse benefits.[24] For example, NbS supports Climate Action (SDG 13) by reducing greenhouse gas emissions and increasing carbon sequestration, as well as boosting resilience to climate-induced disasters including floods and droughts. NbS promotes Life on Land (SDG 15) by efforts like as reforestation and ecosystem restoration, which protect biodiversity, mitigate desertification, and reverse land degradation. Furthermore, NbS improves water quality and availability, aligning with Clean Water and Sanitation (SDG 6), as shown in solutions like wetland restoration and sustainable water management that promote groundwater recharge and ensure freshwater.

In urban areas, NbS contributes to Sustainable Cities and Communities (SDG 11) by decreasing urban heat, improving air quality, and controlling stormwater using green roofs and urban forests, resulting in healthier and more resilient environments. Agroforestry and regenerative farming are agricultural strategies that improve food security and soil fertility, helping to achieve Zero Hunger (SDG 2). Furthermore, NbS helps to achieve Good Health and Well-being (SDG 3) by reducing air and water pollution, creating green areas, and improving overall physical and mental health. By integrating ecological, social, and economic factors, NbS provide a holistic framework for accomplishing the SDGs while tackling pressing issues such as climate change and environmental degradation.

Policymakers and stakeholders are advised to prioritize these solutions in planning and implementation to fully realize their potential for establishing sustainable, resilient communities around the world.[25]

[22] C Nwaogu and MR Cherubin, 'Integrated Agricultural Systems: The 21st Century Nature-Based Solution for Resolving the Global FEES Challenges' [2024] Advances in Agronomy 1.
[23] A Guadagnini, 'Nature-Based Solutions: Overcoming Environmental Challenges, Scaling Impact, and Shaping the Future' (*Environment & Liveability Projects and Advice – Healthy Land & Water*, 16 December 2023) https://hlw.org.au/news/nature-based-solution-overcoming-environmental-challenges-scaling-impact-and-shaping-the-future#gsc.tab=0 accessed 10 December 2024.
[24] B Sowińska-Świerkosz and J García, 'What Are Nature-Based Solutions (NBS)? Setting Core Ideas for Concept Clarification' (2022) 2 Nature-Based Solutions 100009 https://doi.org/10.1016/j.nbsj.2022.100009 accessed
[25] Guadagnini (n 23).

3. BENEFITS OF NATURE-BASED SOLUTIONS

NbS can provide practical and immediate benefits, improving the deleterious effects of climate change and reducing the phenomenon itself. This text will examine the individual benefits of NbS.

(i) NbS to the mitigation of climate change.

According to the IUCN, NbS have the potential to "decrease greenhouse gas emissions related to deforestation and land use [;] capture and store carbon dioxide from the atmosphere and enhance resilience of ecosystems".[26] This is because efforts at ameliorating the harmful effects of land and environmental usage are being done in a more sustainable manner. This issue of sustainability is essential to allow for a cooling-off period in tree felling and the resultant benefit of recovering forests and reduced greenhouse gas emissions. In the absence of efforts to address the root of the climate change problem, there is a natural flow from unsustainability to biodiversity obstacles.

Additionally, it has been noted that NbS could provide up to 30% of the climate change mitigation needed to achieve the goals of the Paris Agreement.[27] This could be why the World Bank has used more than 100 projects between 2012 and 2022 that used NbS for their role in mitigating disasters and supporting climate resilience.[28]Additionally, there has been a global utilization of NbS as part of national climate change strategies, with the majority of efforts being centralized in Africa, East Asia and Pacific regions.[29] This could be because the effects of climate change on these developing countries are more immediately felt.

To address the climate and biodiversity goals, immediate and sustained effort is required to achieve net-zero greenhouse gas emissions by mid-century. To fulfill nationals and global climate targets, a shift to clean energy is required but not sufficient.[30] Transforming our energy system must be accompanied by reducing the amount of greenhouse gases already present in the atmosphere. NbS are among the most effective and efficient ways to achieve this reduction (See Table 1 above).

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[26] International Union for Conservation of Nature (IUCN), *IUCN Global Standard for Nature-Based Solutions: A User-Friendly Framework for the Verification, Design and Scaling Up of NbS: First Edition* (1st edn, IUCN 2020).

[27] K Richards, 'More Countries Including Nature in Their Climate Action Plans, but Step Change Still Needed to' 30 jun. 2024.

[28] B Jongman and S Judson, 'Nature-based solutions for climate resilience are catching on in World Bank projects: Less gray, more green and blue' 30 jun. 2024.

[29] Ibid.

[30] United States of America, *The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050* (US Department of State and Executive Office of the President, 2021)

Researchers predict that, if well designed and managed, these solutions could contribute more than a third of the climate mitigation needed to keep warming below 2 degrees Celsius by 2030.[31] There are also significant differences in mitigation potential between techniques such as afforestation and avoided forest conversion, with gains in biodiversity [32] which are far more effective than techniques such as using biochar or planting trees on cropland, as well as wetland techniques such as coastal restoration and avoided peat impacts.

(ii) NbS to the adaptation of climate change.

NbS can assist communities in adapting to the effects of climate change. The Biden-Harris Administration has taken significant steps to mitigate several of the climate-related threats that are predicted to have the greatest impact on the United States, including wildfire, drought, high heat (on land and at sea), coastal inundation, and inland flooding.[33] Various nature-based remedies can eliminate each of these dangers at a low cost.[34]

Urban trees, for example, may greatly cool the air, reducing the danger of heat stress on people and infrastructure. This benefit can result in lower emissions from electricity production, fewer outages, and up to 47% cost savings on air conditioning.[35] These benefits are not dispersed equitably across all localities, not even in countries such as the United States. Low-income neighborhoods had 15% fewer tree cover than affluent neighborhoods.[36] To reduce the imbalance between these places, researchers predict that 62 million trees would need to be planted, which would benefit 42 million people. [37]

In fact, the United States of America (USA) has a long history of investing in nature to solve critical issues. This approach was precipitated by environmental phenomena in the US, such as the coining of the term the "Dust Bowl" in the 1930s

[31] BW Griscom et al, 'Natural Climate Solutions' (2017) 114(44) *Proceedings of the National Academy of Sciences* 11645–11650.
[32] This paper focused on climate, but the same solutions are effective to achieve the Kunming-Montreal (biodiversity targets) as well (CBD, 2022)
[33] NOAA National Centers for Environmental Information (NCEI), *U.S. Billion-Dollar Weather and Climate Disasters (2024)* (2024) accessed 30 June 2024.
[34] E Cohen-Shacham et al (eds), *Nature-Based Solutions to Address Global Societal Challenges* (IUCN International Union for Conservation of Nature 2016).
[35] DJ Nowak et al, 'Residential Building Energy Conservation and Avoided Power Plant Emissions by Urban and Community Trees in the United States' (2017) 21 Urban Forestry & Urban Greening 158.
[36] CD Ziter et al, 'Scale-Dependent Interactions Between Tree Canopy Cover and Impervious Surfaces Reduce Daytime Urban Heat During Summer' (2019) 116(15) Proceedings of the National Academy of Sciences 7575.
[37] RI McDonald et al, 'The Tree Cover and Temperature Disparity in US Urbanized Areas: Quantifying the Association with Income Across 5,723 Communities' (2021) 16(4) PLOS ONE e0249715.

which was caused by several economic and agricultural factors, including federal land policies, changes in regional weather, farm economics, and other cultural factors.[38]

President Franklin D. Roosevelt advocated for the Prairie States Forestry Project, often known as the "Great Wall of Trees".[39] The federal government paid farmers to plant "shelter belts" of trees surrounding farmlands as part of the project, which employed thousands of rural workers. This Great Wall contained approximately 220 million trees and covered 140,000 square miles from Texas to North Dakota when it was completed in 1942. The trees helped to prevent erosion, protect livestock from windstorms, give shade, and provide habitat for birds and wildlife. Many of those trees are now gone or in decline as America's rural landscapes have transformed. This transformation can be attributed to various factors, such as urbanization, changes in land use practices, and the expansion of agriculture. As a result, the once thriving and protective NbS that once was the "Great Wall of Trees" has been significantly diminished, it is time to reinvest in it to meaningfully benefit the climate, humans, and the natural environment with new laws and investments to foster this type of goal.

Countries across the globe can increase their use of NbS as a means of adaptation to climate change. But there are some examples. Bangladesh has used NbS to provide cost-effective to address the socio-economic challenges associated with environmental degradation in a post-COVID-19 world.[40] In South America, NbS has been used to study the impact of adaptation on biodiversity in the tropical Andean region. For example, the project focuses on the city of Tena in Ecuador.[41] In Ghana and Côte d'Ivoire, projects are looking at traceability to develop policies for sustainable cocoa sourcing. The process is a little easier because the consumer is more likely to be involved in the production chain, particularly in chocolate, tea and coffee. There is a market for sustainable products.[42]

This demonstrates the breadth of applications for NbS as part of not only a national, but also a regional or global plan to adapt to the challenge of climate change. Recognising the implementation of NbS in a strategic sustainability discussion is essential to understanding the role that NbS can play in the world's future. It is also indicative of the multi-faceted approach needed to address the impacts of climate change. Acknowledging that climate change will take time to address, the need for

[38]State Historical Society of Iowa, *Dust Bowl* accessed 9 July 2024.
[39] J Orth, 'The Shelterbelt Project: Cooperative Conservation in 1930s America' (2007) 81(3) Agricultural History 333.
[40] AC Smith et al, 'Nature-Based Solutions in Bangladesh: Evidence of Effectiveness for Addressing Climate Change and Other Sustainable Development Goals' (2021) 9 Frontiers in Environmental Science.
[41] KL Hutchinson, *Biodiversity Outcomes of Nature-Based Solutions for Adaptation in the Tropical Andes* accessed 9 July 2024.
[42] EB Dompreh, R Asare and A Gasparatos, 'Stakeholder Perceptions About the Drivers, Impacts and Barriers of Certification in the Ghanaian Cocoa and Oil Palm Sectors' (2021) 16(6) Sustainability Science 2101.

adaptation in the way states continue their day-to-day business is essential. NbS offers a sustainable way not only to survive, but potentially to thrive.

(iii) Reducing key climate hazards

Numerous NbS have been found helpful in lowering dangers to coasts when used alone or in conjunction with other infrastructure. Conserving or restoring coastal habitats such as oyster reefs, mangroves, and marshes can help prevent coastal flooding while also providing other benefits (Table 1 above). Coastal wetlands mitigated flood losses by 16% on average during Hurricane Sandy.[43] Integrating coastal habitats can improve the effectiveness and longevity of traditional coastal infrastructure.[44] Living shorelines have been shown in studies to be effective at reducing coastal erosion. They can also be more damage-resistant than traditional grey infrastructure solutions like seawalls, necessitating little or no repair after a storm. Living shorelines also benefit coastal habitats, recreation, nature access, and fisheries.[45] These kinds of solutions are essential to adaptation.

An example of interregional projects is the NbS adopted by Jamaica, Bangladesh and the Maldives for resilient infrastructure, including water supply, renewable energy, transport systems and flood protection.[46] The relevance of environmental protection strategies for coastal states is not difficult to understand. But even in larger developed countries, NbS can help with climate hazards. In the US, coastal flooding threatens over 60,000 miles of US roads and bridges, and this number is projected to increase as climate change continues. Without adaptation, the cost of damage to US coastal assets could reach $3.6 trillion by 2100. In fact, restoring coral reefs in Florida and Puerto Rico has the potential to save $272.9 million per year in flood damage, both directly and indirectly.[47] These savings will grow in value over time. However, it is also important to note that calculating losses in monetary terms assumes restoration efforts are possible if the funding is available. Unfortunately, there are other unquantifiable losses, such as irreversible damage to biodiversity and environmental sustainability.

[43] S Narayan et al, 'The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA' (2017) 7(1) Scientific Reports 9463.
[44] VTM Van Zelst et al, 'Cutting the Costs of Coastal Protection by Integrating Vegetation in Flood Defences' (2021) 12(1) Nature Communications 6533.
[45] CS Smith et al, 'Coming to Terms With Living Shorelines: A Scoping Review of Novel Restoration Strategies for Shoreline Protection' (2020) 7 Frontiers in Marine Science.
[46] R Haggis and M Singh, *Nature-Based Solutions for Resilient Infrastructure Systems in Jamaica, Bangladesh and the Maldives* accessed 9 July 2024.
[47] CD Storlazzi et al, *Rigorously Valuing the Coastal Hazard Risks Reduction Provided by Potential Coral Reef Restoration in Florida and Puerto Rico—Open-File Report* (US Geological Survey 2021) accessed 9 July 2024.

In many cases, investing in NbS is more cost-effective and brings greater social benefits. Investment in urban trees and coastal ecosystems are two examples of NbS that can be used to address climate change, natural loss and inequality. These examples, and many others (Table 1 above), show that well-designed NbS often have multiple benefits, even when applied to a limited range of problems. Restoring grasslands and woodlands within a mosaic of farms can improve crop yields by controlling pests and pollination, reduce wind erosion, sequester carbon, provide recreational opportunities and replenish rural habitats. Native Americans developed the technique of carefully managed prescribed burns, which can reduce the extreme risk of wildfire, the negative health effects of smoke and the need to close schools, and improve forest quality to better support cultural uses, endangered species and recreational activities. In many cases, using these tactics will help communities address multiple concerns at once, save money, and build long-term solutions.

4. CHALLENGES TO ACCELERATING NATURE-BASED SOLUTIONS TO CLIMATE CHANGE

Well-designed NbS are critical tools in the fight against climate change, but they are far from reaching their full potential. NbS face numerous legal and policy hurdles that hinder their widespread adoption and efficacy. One of the primary challenges lies in balancing the implementation of NbS with land rights, especially for indigenous and local communities. In many cases, NbS projects require significant tracts of land for initiatives like reforestation or wetland restoration. Without proper safeguards, such projects risk displacing communities or restricting their traditional access to land and resources. For example, in Morocco, community-inclusive NbS projects have faced criticism for insufficient recognition of land tenure rights. This highlights the need for free, prior, and informed consent (FPIC) to ensure equitable access and avoid marginalization.

Another key obstacle is the absence of integrated legal frameworks explicitly supporting NbS. In Nigeria, fragmented environmental laws limit the scale and coherence of NbS initiatives. A lack of a unified strategy has led to policy conflicts and overlapping mandates among institutions responsible for forestry, agriculture, and water management. This duplication of effort diminishes the overall efficiency and impact of NbS programs. By contrast, countries like Costa Rica have successfully integrated NbS into broader environmental policies, demonstrating the benefits of cohesive governance structures.

Financial mechanisms also pose significant barriers. Without robust legal recognition, funding streams for NbS remain underdeveloped. In Morocco, limited access to international carbon markets has constrained investment in green projects. Similarly, Nigeria's lack of legal frameworks for payment for ecosystem services (PES)

discourages private sector participation. Countries like Colombia, which have implemented PES schemes, provide a model for incentivizing NbS while promoting sustainable development. Addressing these challenges requires targeted legal reforms, such as formalizing NbS in national legislation, strengthening land tenure protections, and establishing financial incentives. Countries can draw on lessons from successful initiatives to align conservation objectives with socio-economic development.

The barriers to the widespread use of NbS are complex. There are two main schools of thought that oppose the use of NbS. The first school can be described as the philosophical objectors. This group recognises the benefits of NbS but believes that it can be used as a bandage on a significant wound. For this group, the effect of implementing NbS could be as dangerous as not using it at all. The second school of objectors are those who believe that the infrastructure (physical and know-how) is not in place to allow NbS to realize its true potential in a meaningful way. It may not be entirely appropriate to refer to this second group of voices as objectors per se, but rather as pragmatists.

(i) Philosophical Objections/Concerns

In discussing this part of the paper, the focus will initially be on the philosophical objectors and then on the pragmatists' views. The philosophical challenges to the widespread use of NbS can be found in the Report of the UN Environment Programme.[48] The UNEP Report identified four main arguments against the use of NbS. The first is that NbS could infringe on the rights of indigenous people and local communities through a lack of protection of land tenure rights, restricted access to natural resources, and the resultant inequitable distribution of natural resources.

A second philosophical objection is the misuse through misinterpretation of NbS.[49] This concern stems from implementing one strategy to ameliorate the negative effects of climate change but, in turn, cause tangential environmental harm. Perhaps the most interesting argument against NbS is that it can "distract or detract"[50] from other vital actions required. One given example is that of decarbonization. Some actions can only focus on carbon and miss the real focus, which is on nature and people.

This third philosophical objection is closely connected to the second observation that a lack of knowledge of NbS can cause more harm than good. These three points must be integrated into any strategy, including NbS, as they reflect the real threat to the potential good that a properly implemented NbS can achieve. There is also

[48] UNEP, 'Ministerial Declaration: UNEA-5' (*United Nations Environment Assembly*, 2022) accessed 8 February 2024.
[49] Ibid.
[50] Ibid.

the issue that NbS is not always capable of quantification and certainty in outcomes. This can sometimes result in a lack of awareness of whether NbS will, in fact, achieve the result in the manner that is hoped. This fear is that strategizing solutions with untested outcomes, which are urgent and time-sensitive, may almost be fatal to the adoption of NbS when they are needed most.

While the philosophical concerns represent real conceptual issues that must be considered in any sustainable strategy for climate change management, NbS is associated with even more practical issues. These practical challenges are more tactical than strategic in nature and must be addressed urgently so that NbS can demonstrate its true utility. Attention can now be turned to the views of the pragmatists.

(ii) Pragmatists Objections/Concerns

Pragmatists often highlight the operational and systemic barriers that hinder the effective implementation of NbS, emphasizing that without addressing these, the potential of NbS remains untapped. These barriers frequently stem from a lack of robust infrastructure, technical expertise, and sufficient institutional support. Unlike philosophical objections, which focus on conceptual dabates, pragmatist concerns revolve around the tangible gaps in knowledge, regulatory alignment, and coordination among stakeholders. While the global discourse around NbS acknowledges their transformative potential, practical issues such as integrating NbS into existing frameworks, managing costs, and ensuring scalability pose significant challenges. Bridging these gaps requires clear policies and comprehensive strategies to educate stakeholders, align governance structures, and mobilize resources.

Central to these concerns is the need for more awareness and understanding of NbS among decision-makers, professionals, and communities. Many need to become more familiar with how NbS can be applied to address environmental, social, and economic challenges, leading to underutilisation and missed opportunities. This lack of knowledge extends to quantifying and communicating the benefits of NbS, which hinders their adoption and integration into mainstream planning and policy. Additionally, the absence of shared frameworks and knowledge exchange exacerbates these challenges, limiting the ability of local and indigenous knowledge systems to contribute to sustainable solutions. The following section delves into the specific issue of knowledge gaps and explores how this fundamental barrier impacts the broader adoption of NbS.

a. Lack of knowledge about nature-based solutions

A lot of communities, professionals, and decision-makers are unaware of the benefits of NbS and how they might be used to solve social and economic problems,

which may actually result in political problems.[51] It is this misunderstanding of the potential of NbS that results in its underutilization and frequent disregard. Some people are still confused about how to quantify and account for the advantages of using NbS, as well as where to use them.[52] Also, the potential applications of NbS can be seen in indigenous and local knowledge, which can offer solutions to farming, desertification, pest control, sustainability, healthcare, just to name a few.[53] When relevant sources of information are overlooked in design processes and evaluations, it results in lost opportunities and less effective solutions. Not relegating the discussion to a lack of knowledge, there is also an issue of a lack of the necessary regulatory and policy frameworks for the NbS to be operational. And the need to the policies to be designed differently to contemplate the commons[54] in collective actions forming an orchestra of power to achieve the social interest and a new set of policy tools.[55]

b. Regulatory and policy barriers

NbS confronts unique policy barriers that differentiate it from conventional grey infrastructure. One problem the researchers found when interviewing project managers was that nature-based solutions are too multidisciplinary projects."[56] Regulations and processes may inadvertently favor conventional solutions over natural answers. For example, hazard mitigation typically focuses on conventional solutions (e.g., elevating buildings and utility systems in flood zones and fire-proofing buildings), overlooking opportunities to integrate nature-based solutions such as floodplain restoration and managing neighboring forests to reduce fire risk.

Programs that encourage reconstructing damaged structures in their original state may limit using nature-based alternatives in recovery. Public participation in this report found that regulatory criteria can be difficult to achieve even for measures that are likely to help the environment (e.g., wetland gains, species protection) and that regulators' lack of awareness may cause agency approval processes to be delayed.

Some funding policies also present barriers. For example, cost-sharing restrictions on some government funding can be a barrier for the less fortunate. On a very practical level, policies and regulations are usually lacking if governments do not

[51] Y He et al, 'Negotiating Complexity: Challenges to Implementing Community-Led Nature-Based Solutions in England Pre- and Post-COVID-19' (2022) 19(22) International Journal of Environmental Research and Public Health 14906.
[52] T Shiao et al, *Business Case for Nature-Based Solutions: Landscape Assessment* accessed 9 July 2024.
[53] XH Jones, D Roe and E Holland, *Nature-Based Solutions in Action: Lessons from the Frontline* (IIED, Canada 2021).
[54] KW Abbott, *Orchestration: Strategic Ordering in Polycentric Climate Governance* accessed 25 June 2017.
[55] B Cashore et al, 'Policy Design for Biodiversity: How Problem Conception Drift Undermines "Fit-for-Purpose" Peatland Conservation' (2024) Policy and Society puae019.
[56] J Linnerooth-Bayer and A Scolobig, *Tackling Policy Barriers to Nature-Based Solutions* accessed 10 July 2024.

see the economic or social benefit of these time-consuming endeavours. This is largely due to the significant financial challenges associated with NbS, which are now being addressed.

c. Difficulties in accounting for costs and benefits

There is almost a trifecta of financial challenges for NbS: a "lack of evidence on performance and co-benefits".[57]. This implies limited funding opportunities; and high implementation cost, and the lack of financial incentives for States that actually use NbS.[58] The totality of these financial realities for States is that NbS may represent a financially unviable strategy for tackling the climate change threat. It can be argued that even if one could access the necessary financial resources to implement NbS, there is still the issue of how to quantify the benefit of the initiative. Where there is strong evidence, standards have been developed, and NbS can be widely applied. Where solutions lack clear proof of long-term performance and reliability, their use may be limited. Small-scale testing and investigation of only a few of the important costs and benefits often dominate the evidence that does exist. Demonstration projects, research, and long-term observations are required to continue establishing a strong evidence base for all forms of nature-based solutions and their benefits and to understand how to adapt solutions to future changes.

Many of the benefits provided by NbS fall outside of normal economic accounting systems and procedures. Since these advantages are not publicly traded in a market, commercial systems and tools frequently overlook their relevance, bypassing judgments favoring advertised alternatives. Wild pollinators increase crop value, but their contribution is difficult to discern in the price of a basket of strawberries. The potential of a forest or coral reef to mitigate flood damage is masked by higher housing values or lower insurance premiums. Furthermore, some benefits of natural remedies, such as spiritual experiences, should not be marketed. Many agency guideline materials and accounting tools fail to reflect the full spectrum of advantages that nature-based solutions can offer. Some nature-based solutions continue to have data or modeling gaps, particularly in identifying long-term repercussions and specifying who wins or loses these advantages, making it difficult to evaluate equity consequences or design these approaches to address past injustices.

d. Lack of information and skills at various governmental levels

Implementing NbS necessitates different methodologies, tools, and skills than conventional options, and lacking these talents might stymie adoption. A recent

[57] Ibid.
[58] RS Mishr, *Overcoming Financial and Non-Financial Barriers in Implementing Nature-Based Solution Projects* accessed 10 July 2024.

federal study[59] identified 177 materials developed to assist in developing these abilities. According to this evaluation, most existing resources give generic information, such as case studies and process overviews. Few available resources provide the tools, direction, and technical assistance required for implementation. Most available government resources, including those generated in collaboration with non-federal partners, address risk reduction and resilience, with a primary emphasis on coastal flooding. Other increasingly common catastrophic catastrophes (e.g., inland flooding, fire, drought, excessive heat) continue to leave gaps. According to public feedback, to close any remaining capacity shortages, greater technical resources and workforce development initiatives are required.

e. Coordination failures

NbS normally fail to stablish an efficient price mechanism to regulate market The coordination failures resulting from the price mechanism open up space for strategic actions on the part of autonomous and self-interested agents. In other words, to capture additional value through the coordination of agents for the use of specific assets, they can use informational and contractual incompleteness in their favour, generating exogenous disturbances in a situation of bilateral dependence, a form of adaptation, in co-operation.[60]

For this author, transactions carried out in the market fall within the logic of autonomous adaptation, which would be sufficient to guarantee the maintenance of the alignment of incentives between economic agents in the face of unforeseen disturbances. Hierarchy, on the other hand, has the characteristics of dependence on bilateral relations between the contracted parties which is why coordination would be more appropriate to guarantee contractual adaptation. In the context of hierarchy, where adaptations are coordinated, bureaucratic costs are higher when compared to the use of the market.

f. A complete shift in the policy analysis: focus to the prioritization

Professor Ben Cashore's research suggests that we need to make a fundamental change in how we approach policy analysis. Instead of viewing environmental crises as trade-offs, optimization problems, or even the commons, we should see them as challenges that require prioritization. This shift in perspective calls for four main tasks in policy design: arranging tasks in a specific order, identifying crucial aspects that any solution must address to be effective, examining the influence of historical decisions on current policy options, and organizing collaborative learning activities involving various stakeholders to incorporate diverse knowledge from

[59] CEQ, *Opportunities for Accelerating Nature-Based Solutions: A Roadmap for Climate Progress, Thriving Nature, Equity, and Prosperity. Report to the National Climate Task Force* (White House, 2022)
[60] Williamson OE, 'Strategizing, Economizing, and Economic Organization' (1991) 12 Strategic Management Journal 75

ecological and political sciences with abilities to identify and create lock-ins that remains in place no matter the shift in government. This is the NBS type of policy we should look forward to producing.

The proposed framework shifts the concept of the business case from a narrow, all-government or total profit-centred perspective to a pluralistic and inclusive "all stakeholders win" approach. This model emphasizes creating value for a wide range of stakeholders, including businesses, communities, and the environment. By integrating environmental, social, and economic objectives, the framework advocates for collaborative strategies that unite businesses, governments, and civil society to address complex sustainability challenges. Central to this proposal are three key elements: impact orientation, which focuses on measurable and meaningful environmental and social outcomes; collaborative approaches, which encourage cross-sector partnerships to co-create innovative solutions; and economic restraint, which prioritizes long-term sustainability over short-term profit maximization. By embedding these principles, the framework aspires to align corporate actions with broader societal and ecological needs, ensuring a just and sustainable transition for all.

g. **Legal and Policy Challenges in Implementing NbS**

Nature-based solutions (NbS) encounter severe legal and policy difficulties, limiting their widespread adoption and efficacy.[61] One of the most significant challenges is the tension between NbS activities and land rights, with particular emphasis on the ramifications for local and indigenous groups. Reforestation and wetland restoration projects can need huge expanses of land, potentially displacing or restricting access to populations who rely on traditional land use practices. For example, recent studies in Morocco show how NbS projects might unintentionally marginalize disadvantaged people if land tenure rights and free, prior, and informed consent (FPIC) are not appropriately handled. This highlights the need of legislative frameworks that promote human rights and equal access to resources.[62]

Another important shortcoming is the absence of comprehensive national initiatives or legislation that specifically supports NbS.[63] In Nigeria, the lack of a single NbS legal framework forces reliance on fragmented environmental rules, restricting the scale and coherence of NbS initiatives. A well-defined national strategy that incorporates climate, ecological, and social goals might bring these activities together, promoting consistency and effectiveness. Similarly, in Morocco, while several green

[61] IUCN, *IUCN Global Standard for Nature-based Solutions: A User-Friendly Framework for the Verification, Design and Scaling Up of NbS: First Edition* (IUCN 2020)
[62] Nathalie Seddon and others, 'Getting the Message Right on Nature-Based Solutions to Climate Change' (2021) 27 *Global Change Biology* 1518 https://doi.org/10.1111/gcb.15513
[63] Hongpeng Fu, 'A Comprehensive Review of Nature-Based Solutions: Current Status and Future Research' (2023) 10 *AIMS Environmental Science* 677 https://doi.org/10.3934/environsci.2023037

projects are underway, the lack of comprehensive legislation addressing NbS challenges their integration with broader sustainability aims.

Another major challenge is institutional cooperation. In Nigeria, overlapping mandates among institutions responsible for forestry, agriculture, and water management result in policy inconsistencies and duplication of effort.[64] Morocco confronts comparable issues, with dispersed governance systems preventing national coordination for NbS programs. To solve this, defined inter-agency roles and communication procedures must be established, enabling unified governance and effective resource allocation.

A further difficulty is that NbS has limited legal recognition and finance mechanisms.[65] Despite success in implementing green programs, Morocco's legal framework does not explicitly highlight NbS as a cornerstone of climate action, limiting funding and expansion. Nigeria also faces difficulties in attracting investment in NbS due to a lack of enabling legislation and financial incentives, such as carbon markets or subsidies. Establishing formal legal recognition for NbS and developing robust finance channels are critical to realizing their full potential and promoting business sector participation.

Finally, reconciling conservation objectives with economic development goals remains a major challenge. In Morocco, discussions about allocating agricultural land for conservation highlight the contradictions between environmental sustainability and economic priorities. Similarly, Nigeria's emphasis on extractive sectors frequently clashes with NbS objectives, making it difficult to prioritize ecosystem restoration. Legal measures must balance these tensions by incorporating NbS into larger development planning frameworks, ensuring that conservation and economic growth goals are aligned.

Addressing these issues through specific legal and policy reforms is critical to realizing the full potential of NbS.[66] Lessons from Morocco's community-inclusive NbS projects and Nigeria's green development policies should help other countries experiencing similar challenges. Countries can use NbS to transform sustainable

[64] David V Ogunkan, 'Achieving Sustainable Environmental Governance in Nigeria: A Review for Policy Consideration' (2022) 2(1) *Urban Governance* 212 https://doi.org/10.1016/j.ugj.2022.04.004
[65] Lieke M Hüsken and others, 'Money Talks: A Systems Perspective on Funding and Financing Barriers to Nature-Based Solutions' (2024) 6 *Nature-Based Solutions* 100200 https://doi.org/10.1016/j.nbsj.2024.100200
[66] Donald R Nelson and others, 'Challenges to Realizing the Potential of Nature-Based Solutions' (2020) 45 *Current Opinion in Environmental Sustainability* 49 https://doi.org/10.1016/j.cosust.2020.09.001

development and climate resilience by establishing equitable, coordinated, and well-funded frameworks.

5. DISCUSSION – LEGAL FRAMEWORK, POLICIES AND GOVERNANCE ORIENTED TO NATURE-BASED SOLUTIONS

The crises of climate change, biodiversity loss, land degradation, pollution and waste require immediate action. We are in the UN Decade of Ecosystem Restoration, which supports global commitments to restore one billion hectares of ecosystems worldwide, and reforestation, afforestation and land restoration are key nature-based solutions, that when are done in urban areas provide a vital link to nature in an increasingly urbanized world, helping to cool extreme temperatures, solving social problems at the same time.

Unfortunately, NbS are underfunded. They receive only US$200 billion a year globally,[67] less than a third of what will be needed annually by 2030 to meet climate, biodiversity and land degradation targets. They are also undermined by US$7 trillion of nature-destroying finance flowing annually through harmful subsidies and investments. Given these figures, it's clear that redirecting nature-destroying financial flows is the best way to halt and reverse nature loss. Laws, policies and governance are not working to facilitate the process of implementing the NbS in practice.

A stable climate, healthy nature and a pollution-free planet are the bedrock of our societies and economies. The legal framework and a set of public policies can create a positive environment to increase the use of NbS as critical tools in the battle against climate change.

Some core principles[68] must be followed: 1) NbS cannot replace conservation. However, it is important to note that not every conservation measure qualifies as an NbS. 2) NbS works best when integrated with other solutions to societal challenges. This requires policy coherence. 3) Use evidence-based data on particular ecosystems from natural and cultural contexts. 4) Produce societal benefits fairly and equitably first to local communities, then going on to regional, national, and planetary. 5) Maintain biological and cultural diversity to increase resilience. 6) Combine several ecosystems (agricultural, inland waters, coastal, forest, etc.) at a landscape scale, which might, in some cases, bring transboundary regulatory challenges. 7) Acknowledge and tackle the balance between prioritizing short-term economic gains for development and preserving future opportunities for accessing a diverse array of ecosystem services. 8)

[67] UNEP, *Ministerial Declaration: UNEA-5* https://www.unep.org/environmentassembly/unea5 accessed 8 February 2024

[68] E Cohen-Shacham and others, 'Core Principles for Successfully Implementing and Upscaling Nature-Based Solutions' (2019) 98 Environmental Science & Policy 20

NbS are transdisciplinary and combined efforts intrinsically bound to the design of policies, and the measures or actions.

Challenges NbS are determined by natural and cultural contexts specific to the site, which include traditional, local, and scientific knowledge that is yet very difficult to translate into broad political language and international standards. The new approaches are yet to be created by academia around the world based on a comprehensive understanding of particular ecosystems, supported by evidence from various sources, including science, traditional knowledge, or a combination of the two, which *per se* is a challenge to the way science has been made past centuries.

But to ensure effectiveness, NbS must consider this broad understanding of the natural and cultural contexts, including traditional, local, and scientific knowledge. This can be achieved by involving stakeholders who live in and have a vested interest in the ecosystem. Full participation in the development of NbS is essential. As with any successful governance, understanding and providing a process for fair and transparent negotiation of trade-offs is essential for ensuring a successful NbS.

To effectively implement NbS and address the stated problems, states must make targeted legislative and regulatory changes.[69]

First, existing environmental and land-use laws need to be revised to expressly acknowledge and protect indigenous peoples' and local communities' land rights. Including procedures for free, prior, and informed consent (FPIC) in NbS initiatives will enable meaningful participation while preventing displacement.[70] Morocco, for example, might formalize participatory land-use planning to support community-inclusive NbS programs while adhering to international standards like the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).

Second, states must build comprehensive national strategies that incorporate NbS into their climate action, biodiversity conservation, and socioeconomic objectives. A unified approach can bring together disparate laws and regulations, as shown in Nigeria, where the absence of a single NbS framework impedes scale and coherence. To achieve accountability and long-term effectiveness, such programs should include specific goals, strong funding sources, and monitoring methods.

Third, institutional coordination should be strengthened by rearranging organizations and clarifying mandates. Overlapping responsibilities amongst government institutions, as seen in Nigeria and Morocco, result in inefficiencies and

[69] Ibid.
[70] 'What Is Free, Prior and Informed Consent (FPIC)?' (*IHRB*) <https://www.ihrb.org/resources/what-is-free-prior-and-informed-consent-fpic> accessed 10 December 2024

policy inconsistencies. Establishing specific NbS agencies or inter-agency task forces with formal agreements can help to streamline duties and enhance collaboration. Centralized governance arrangements, such as a national NbS task force, can serve to coordinate activities across sectors and levels of government.

Fourth, states should formally acknowledge NbS in their legal frameworks and provide novel funding structures to attract investment.[71] Integrating NbS into climate and environmental legislation will boost their standing as vital tools for sustainable development.[72] Payment for ecosystem services (PES), carbon credits, and green bonds are all examples of financing solutions that might encourage private sector participation. For example, Nigeria might use carbon trading schemes to support NbS projects, while Morocco could broaden its green project portfolio to include NbS-focused efforts. Public funding streams and public-private partnerships will also play an important role in guaranteeing financial stability.

Finally, legal mechanisms must strike a balance between conservation goals and economic growth objectives by incorporating NbS into larger planning frameworks. Strategic environmental assessments (SEAs) should be required for all significant development projects to prioritise NbS alongside economic activities. Nigeria should include mandated NbS offsets for environmental deterioration in its extractive industries, fostering ecosystem restoration while boosting economic activity. Similarly, Morocco may incorporate NbS into its agriculture policies, promoting sustainable land-use methods that are consistent with both conservation and commercial objectives.

States may resolve land rights concerns, improve institutional coordination, ensure financial sustainability, and align conservation and development by putting these specific reforms in place. These steps will ensure that NbS are not only effective, but also equitable and sustainable, providing long-term benefits to both people and the environment.

6. CONCLUSION

A NbS to climate change is a promising approach that harnesses the power of nature to combat climate change and other environmental phenomena. Is a concept transdisciplinary to law, political science, economy, management, agronomy forestry

[71] (*Investing in nature-based solutions*) <https://www.eib.org/attachments/lucalli/20230095_investing_in_nature_based_solutions_en.pdf> accessed 10 December 2024

[72] (*Integrating nature-based solutions into policies for climate ...*) <https://portals.iucn.org/library/sites/library/files/documents/2022-030-En.pdf> accessed 10 December 2024

and many other fields. There are so many possibilities of solutions, such as reforestation, coastal restoration, and sustainable agriculture, they offer a range of benefits, including carbon sequestration, enhanced biodiversity, and social and economic co-benefits. However, there are several legal, policy and administrative challenges that need to be addressed in order to effectively develop and implement NbS.

While this paper has outlined the potential benefits of NbS, it is crucial to highlight the need for international cooperation and collaboration. Climate change is a global issue that requires a global response, and addressing the legal, policy and administrative challenges will require a collective effort. It is important to ensure that NbS are implemented in a way that respects and includes the rights and knowledge of Indigenous peoples and local communities and minorities. By prioritizing these considerations, we can accelerate the adoption of NbS and make significant progress in combating climate change.

Conclusively, achieving meaningful and lasting change will require a comprehensive and inclusive approach that involves all stakeholders, including governments, businesses, civil society organizations, and individuals. It is imperative to establish mechanisms for sharing knowledge, resources, and best practices across nations, fostering a sense of global responsibility and cooperation. Implement a new set of policies focused on challenges and building lock-ins that cannot be changed by the unpredictability of politics. Only through collective action and collaboration can we effectively mitigate the impacts of climate change and create a sustainable future for generations to come.

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Credit

Eduardo G. Pereira and Danielle M.T. Denny actively participated in the discussions of the research results. They validated the results and contributed to the visualisation of the data. Proofread and edited the article, ensuring clarity and cohesion. They played a key role in writing and approving the article.

Timothy Affonso and Dominique Mouette contributed to reviewing the data, acquiring funding and practical research. They contributed significantly to defining the methodology used. They played a supervisory role, ensuring the quality and direction of the work.