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Nature-based solutions for future earth: harnessing the power of ecosystems

Abstract

Nature-based solutions (NbS) offer a promising approach to address the complex environmental challenges facing Future Earth. By harnessing the power of ecosystems, NbS provides innovative and sustainable strategies for solving a wide range of societal issues while promoting biodiversity conservation and ecosystem resilience. This article explores the concept of NbS and its potential applications in shaping a sustainable and ecologically sound future. The article begins by defining NbS and highlighting its fundamental principles, which include the use of natural processes, the integration of social and ecological systems, and the enhancement of ecosystem services. It then delves into the various domains where NbS can make a significant impact, such as climate change adaptation and mitigation, water management, urban planning, and disaster risk reduction. Drawing upon real-world examples and case studies, the article showcases the effectiveness of NbS in diverse contexts. From restoring coastal wetlands to protect against sea-level rise to implementing green infrastructure in urban areas for stormwater management, NbS demonstrates its potential as a cost-effective and resilient alternative to conventional approaches. Furthermore, the article discusses the multiple co-benefits associated with NbS, including improved air and water quality, enhanced human health and well-being, and the promotion of sustainable livelihoods. It highlights the importance of stakeholder engagement and collaboration among scientists, policymakers, communities, and businesses in implementing NbS at various scales. Lastly, the article addresses the challenges and barriers to widespread adoption of NbS, such as policy frameworks, financing mechanisms, and knowledge gaps. It calls for integrated approaches that combine scientific knowledge, traditional ecological knowledge, and innovative technologies to unlock the full potential of NbS. In conclusion, this article emphasizes the crucial role of NbS in creating a sustainable and resilient Future Earth. By recognizing and valuing the services provided by ecosystems, we can forge a path towards a harmonious coexistence with nature while addressing pressing societal needs. Through the harnessing of the power of ecosystems, NbS offers a transformative approach to building a sustainable future for all.

Keywords: nature based solutions, eco-system based approaches, climate change mitigation, biodiversity conservation, sustainable development, resilience

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Introduction

In an era of increasing environmental challenges, finding innovative and sustainable solutions to safeguard the health of our planet and promote human well-being is paramount. Nature-based solutions (NbS) have emerged as a promising approach to address these complex issues, harnessing the power of ecosystems to create a sustainable future for Earth. By integrating ecological processes with human needs and aspirations, NbS offers a holistic framework that can effectively tackle a wide range of societal and environmental challenges.

The concept of NbS recognizes that nature is not just a backdrop or resource to be exploited, but a fundamental ally in promoting resilience, biodiversity conservation, and ecosystem services. Unlike conventional approaches that often rely on engineering and technological interventions, NbS emphasizes working with, rather than against, nature. It draws upon the inherent capacity of ecosystems to provide cost-effective and sustainable solutions, thereby fostering a harmonious relationship between human activities and the natural world.

Research has shown that NbS can deliver numerous benefits. For instance, urban green spaces have been found to improve mental health and well-being,[1] while the restoration of wetlands contributes to flood protection and water purification.

NbS also aligns with global initiatives such as the Convention on Biological Diversity, which recognizes the importance of safeguarding ecosystems for the well-being of present and future generations. Moreover, the United Nations Environment Program and United Nations Development Program have both highlighted the potential of NbS to address climate change, biodiversity loss, and pollution.[2]

This article aims to explore the concept of NbS and its potential to shape a sustainable and ecologically sound future for Earth. It will delve into the fundamental principles that underpin NbS, including the use of natural processes, the integration of social and ecological systems, and the enhancement of ecosystem services. By capitalizing on these principles, NbS offers a transformative framework that can revolutionize how we address environmental challenges.

Renewable energy sources

As the world grapples with the urgent need to address climate change and transition towards a sustainable future, nature-based solutions (NbS) have emerged as a powerful approach to mitigate environmental impacts and promote resilience. Among the key areas of focus, harnessing the power of ecosystems in conjunction with renewable energy sources holds immense potential for shaping a sustainable future for Earth.

Renewable energy sources, such as solar power, wind energy, geothermal energy, and hydroelectric power, have gained significant traction as alternatives to fossil fuels. These sources provide clean, abundant, and low-carbon energy, reducing greenhouse gas emissions and mitigating the impacts of climate change. In parallel, NbS harness the inherent capabilities of ecosystems, promoting biodiversity conservation, enhancing natural processes, and delivering valuable ecosystem services. Integrating NbS with renewable energy sources presents a unique opportunity to maximize the benefits of both approaches while minimizing potential negative environmental impacts.[3]

Research has demonstrated the potential synergies between NbS and renewable energy sources. For example, solar energy projects can be combined with the establishment of pollinator-friendly habitats, benefiting both energy generation and biodiversity conservation. Wind farms can be designed in ways that minimize their impact on bird migration routes and nesting grounds, while simultaneously utilizing the land underneath for agroforestry or rewilding initiatives.[4]

The co-location of renewable energy infrastructure with NbS not only enhances ecological resilience but also contributes to social and economic well-being. Community-based renewable energy projects integrated with NbS can empower local communities, create job opportunities, and improve access to clean energy while restoring and conserving natural habitats.[5] Furthermore, NbS can support renewable energy installations by providing ecosystem services like water filtration, erosion control, and climate regulation, thereby enhancing the performance and longevity of such infrastructure

Sustainable transportation

Nature-based solutions (NbS) are strategies that utilize the power of ecosystems to address societal and environmental challenges. Sustainable transportation is a critical aspect of future Earth, as it plays a significant role in reducing greenhouse gas emissions and promoting environmental sustainability. By integrating nature-based solutions into transportation systems, we can achieve more sustainable and resilient infrastructure. Here are a few examples of how nature-based solutions can be harnessed for sustainable transportation, along with relevant references:

Green infrastructure and urban planning: Green infrastructure refers to the strategically planned network of natural areas, such as parks, forests, and wetlands, within urban settings. Integrating green infrastructure into urban planning can provide multiple benefits for sustainable transportation. For instance, creating pedestrian-friendly green spaces, bike lanes, and tree-lined streets can encourage active modes of transportation and reduce reliance on cars.[6]

Eco-friendly mobility: Nature-based solutions can promote eco-friendly mobility options, such as electric vehicles (EVs) and public transportation. By expanding EV charging infrastructure and incentivizing the adoption of electric vehicles, cities can reduce air pollution and greenhouse gas emissions associated with traditional gasoline-powered vehicles.[7]

Natural drainage systems: Nature-based solutions can also enhance transportation infrastructure by incorporating natural drainage systems, such as bioswales and rain gardens. These features can capture and treat storm water runoff, reducing pollution and improving water quality. Integrating such systems along roadways and parking lots can minimize the impact of transportation-related runoff on water bodies.[8]

Biodiversity corridors: Biodiversity corridors are ecological connections that link fragmented habitats, enabling the movement of species across landscapes. By incorporating biodiversity corridors in transportation planning, we can reduce habitat fragmentation caused by roads and promote wildlife conservation. These corridors can also enhance ecosystem resilience and contribute to carbon sequestration.[9]

Waste management and recycling

Nature-based solutions can play a crucial role in waste management and recycling by harnessing the power of ecosystems. These solutions leverage natural processes to reduce waste generation, promote recycling and composting, and minimize the negative environmental impacts of waste.

Composting and organic waste management: Composting is a nature-based solution that involves the decomposition of organic waste materials into nutrient-rich compost. This process not only diverts waste from landfills but also produces a valuable soil amendment that can enhance soil fertility and carbon sequestration.[10]

Wetland systems for wastewater treatment: Constructed wetlands utilize natural processes, including plants, microorganisms, and soil, to treat wastewater effectively. These wetland systems help remove pollutants and nutrients from wastewater, providing an environmentally friendly alternative to conventional wastewater treatment methods.[11]

Bioremediation and land reclamation: Nature-based solutions can be employed for bioremediation, which involves using plants and microorganisms to clean up contaminated sites. By harnessing the power of ecosystems, we can naturally break down and remove pollutants from soil and water, restoring the health of the environment.[12]

Sustainable forest management and timber recycling: Sustainable forest management practices ensure the responsible use of timber resources, minimizing waste generation and environmental impacts. Additionally, recycling timber from construction and demolition waste can contribute to a circular economy, reducing the need for new resource extraction.[13]

Conservation of natural resources

Conservation of natural resources is vital for ensuring a sustainable future for our planet. Nature-based solutions (NbS) offer innovative approaches to harness the power of ecosystems for the conservation of natural resources. These solutions leverage the inherent resilience and productivity of ecosystems to protect and sustainably manage valuable resources.

Forest conservation and restoration: Forests play a crucial role in conserving natural resources such as biodiversity, water, and carbon. Nature-based solutions like forest conservation and restoration efforts help protect and restore forest ecosystems, ensuring the sustainable management of timber, water resources, and habitat for countless species.[14]

Sustainable agriculture and agroforestry: Promoting sustainable agricultural practices and integrating agroforestry systems can help conserve natural resources in farming landscapes. Agroforestry combines trees with agricultural crops or livestock, providing multiple benefits such as soil conservation, biodiversity conservation, and improved water management.[15]

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Marine and coastal ecosystem conservation: Nature-based solutions can also be applied to marine and coastal ecosystems to protect and conserve valuable resources like fisheries, coral reefs, and mangroves. Examples include establishing marine protected areas, implementing sustainable fishing practices, and restoring degraded coastal habitats.[16]

Water resource management and watershed protection: Nature-based solutions in water resource management focus on protecting and restoring watersheds, wetlands, and natural water retention areas. These approaches enhance water quality, promote natural water storage, and reduce the impacts of floods and droughts.[17]

Climate change and mitigation

Harnessing the power of ecosystems through nature-based solutions (NbS) is crucial for addressing climate change and its mitigation. Ecosystems provide numerous benefits, such as carbon sequestration, climate regulation, and adaptation to changing conditions.

Forest conservation and restoration: Forests act as carbon sinks, absorbing and storing significant amounts of carbon dioxide from the atmosphere. Protecting and restoring forests can help mitigate climate change by reducing greenhouse gas emissions and enhancing carbon sequestration.[18]

Wetland restoration and conservation: Wetlands, including marshes and swamps, store large quantities of carbon and play a vital role in climate regulation. Restoring and conserving wetland ecosystems can help mitigate climate change by reducing emissions from degradation and supporting carbon sequestration.[19]

Agroforestry and sustainable agriculture: Agroforestry systems combine trees with agricultural crops or livestock, providing multiple benefits including carbon sequestration, soil improvement, and enhanced resilience to climate change. Implementing sustainable agricultural practices can also reduce greenhouse gas emissions from the agricultural sector.[20]

Coastal ecosystem conservation and blue carbon: Coastal ecosystems such as mangroves, sea grasses, and saltmarshes sequester and store significant amounts of carbon, a concept known as blue carbon. Conserving and restoring these ecosystems can contribute to climate change mitigation by preserving their carbon stocks and reducing emissions from coastal degradation.[21]

Sustainable urban development

Nature-based solutions (NbS) can play a significant role in promoting sustainable urban development by harnessing the power of ecosystems. These solutions integrate nature into urban areas, enhancing resilience, biodiversity, and quality of life for urban dwellers.

Green infrastructure and urban parks: Green infrastructure, including parks, green roofs, and urban forests, can provide multiple benefits for sustainable urban development. These features help mitigate urban heat island effects, improve air quality, reduce storm water runoff, and enhance recreational spaces for residents.[1]

Urban agriculture and rooftop gardens: Promoting urban agriculture and rooftop gardens can contribute to sustainable urban development. These initiatives provide fresh food, reduce food transportation emissions, enhance urban biodiversity, and improve community engagement and social cohesion.[22]

Pedestrian and cycling infrastructure: Investing in pedestrian and cycling infrastructure, such as walkways, bike lanes, and greenways, promotes sustainable mobility and reduces reliance on private vehicles. These infrastructure elements enhance active transportation, improve air quality, and contribute to healthier and more livable cities.[23]

Biodiversity conservation and urban parks: Integrating biodiversity conservation into urban planning, through protected areas, urban parks, and green corridors, helps maintain ecological balance and supports urban ecosystems. Preserving and enhancing biodiversity in cities contributes to climate resilience, ecological connectivity, and overall urban sustainability.[24]

Environment education and awareness

To become a relevant driver of future ecosystems, nature-based solutions (NbS) can be enhanced by environmental education and awareness. Education plays a crucial role in fostering a deeper understanding of the environment, promoting sustainable behaviors, and empowering individuals to take action for a more sustainable future.

Environmental education in natural settings: Engaging in outdoor and experiential learning activities in natural settings can enhance environmental education. By directly experiencing and interacting with ecosystems, individuals develop a stronger connection to nature and gain a deeper understanding of ecological processes and the importance of conservation.[25]

Citizen science initiatives: Citizen Science projects involve the participation of the public in scientific research, often related to environmental monitoring or biodiversity conservation. Engaging individuals in data collection and analysis fosters environmental awareness, scientific literacy, and encourages active participation in conservation efforts.[26]

Sustainable living education: Promoting sustainable living practices through education helps individuals adopt environmentally friendly behaviors in their daily lives. Topics such as waste reduction, energy conservation, water conservation, and sustainable transportation can be integrated into educational curricula, raising awareness and promoting sustainable choices.[27]

Environmental awareness campaigns: Environmental awareness campaigns play a crucial role in raising public consciousness about environmental issues and promoting behavior change. These campaigns can utilize various media platforms, public events, and educational materials to disseminate information, inspire action, and foster a sense of environmental responsibility.[28]

Circular economy

Nature-based solutions (NbS) can be integrated with the principles of the circular economy to promote sustainable resource management. The circular economy aims to minimize waste, maximize resource efficiency, and promote the reuse and recycling of materials.

Green infrastructure and biomimicry: Green infrastructure, such as green roofs and living walls, can be designed using principles inspired by nature (biomimicry). Mimicking natural systems and processes can enhance resource efficiency, optimize material use, and promote circularity in construction and urban design.[29]

Ecosystem-based waste management: Nature-based solutions can be employed in waste management practices to promote circularity. For example, composting organic waste and utilizing it as a nutrient-rich soil amendment for agriculture or landscaping aligns with the circular economy principles of resource recovery and closing nutrient loops.[30]

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Restoration and regeneration of ecosystems: Restoring degraded ecosystems and promoting their regeneration can contribute to the circular economy by revitalizing natural resource cycles. For instance, reforestation efforts can restore the water cycle, enhance soil health, and promote the sustainable production of timber and non-timber forest products.[31]

Sustainable agriculture and food systems: Applying circular economy principles to agriculture and food systems involves reducing food waste, optimizing resource use, and promoting circular practices such as agro ecology, regenerative agriculture, and farm-to-fork initiatives. These approaches minimize waste, enhance soil health, and contribute to a more sustainable and resilient food system.[32]

Sustainable water management

Nature-based solutions (NbS) can greatly contribute to sustainable water management. Ecosystems provide various water-related services such as water purification, flood regulation, and water storage. By integrating nature-based solutions into water management practices, we can enhance water security, improve water quality, and promote ecological balance.

Wetland restoration and conservation: Wetlands play a vital role in sustainable water management by acting as natural water filters and providing flood regulation. Protecting and restoring wetland ecosystems can improve water quality, retain excess water during heavy rainfall, and recharge groundwater resources.[33]

Riparian zone management: Riparian zones, the areas along rivers and streams, are critical for maintaining water quality and ecological balance. Implementing nature-based solutions in riparian areas, such as reforestation and vegetative buffer strips, can help reduce soil erosion, filter pollutants, and improve water retention.[34]

Green infrastructure for stormwater management: Green infrastructure, including rain gardens, bioswales, and permeable pavements, can effectively manage stormwater runoff while providing multiple benefits. These nature-based solutions help infiltrate and store rainwater, reducing the burden on traditional stormwater infrastructure and minimizing water pollution.[35]

Watershed management and forest conservation: Protecting and managing forested watersheds is crucial for sustainable water management. Forests act as natural water towers, regulating water flow, reducing soil erosion, and improving water quality. Implementing nature-based solutions in watershed management can ensure a sustainable supply of clean water.[36]

Green technologies and innovation

Nature-based solutions (NbS) can be complemented by the integration of green technologies and innovation. Green technologies refer to environmentally friendly technologies that reduce resource consumption, minimize pollution, and promote sustainable practices. By combining nature-based solutions with green technologies and innovation, we can enhance the sustainability and efficiency of our systems.

Renewable energy and ecosystem integration: Integrating renewable energy sources, such as solar panels or wind turbines, with nature-based solutions can create synergies and enhance sustainability. For instance, solar panels installed on green roofs or floating solar farms can utilize underutilized spaces while preserving and enhancing ecosystems.[37]

Smart grids and ecosystem services: Smart grid technologies, combined with nature-based solutions, can optimize energy distribution and reduce environmental impacts. By incorporating sensors and real-time data, smart grids can enhance energy efficiency, promote renewable energy integration, and support the sustainable management of ecosystems and their services.[38]

Green building and sustainable infrastructure: Green building practices and sustainable infrastructure design can be integrated with nature-based solutions to create environmentally friendly and resource-efficient structures. This can include features such as energy-efficient systems, water-saving technologies, and materials with low environmental footprints.[39]

Circular economy and eco-innovation: By embracing circular economy principles and eco-innovation, nature-based solutions can be integrated with green technologies to optimize resource use, minimize waste, and promote sustainable production and consumption. This can involve the development of eco-friendly materials, recycling technologies, and innovative business models.[40]

Sustainable lifestyle

Nature-based solutions (NbS) can be coupled with promoting sustainable consumption and lifestyle choices. Sustainable consumption aims to minimize resource use, reduce waste generation, and promote responsible consumption patterns.

Sustainable food systems: Promoting sustainable food systems, such as organic farming, agroecology, and local food production, can reduce the environmental impact of food production and consumption. Nature-based solutions like urban agriculture and community gardens can encourage sustainable food practices, improve food security, and promote healthier diets.[41]

Eco-friendly transportation: Encouraging sustainable transportation options, such as walking, cycling, and public transit, can reduce greenhouse gas emissions and air pollution. Integrating nature-based solutions like greenways, urban forests, and green corridors can enhance the appeal of these sustainable transportation options, making them more accessible and enjoyable.[42]

Minimalism and circular economy: Promoting minimalist and circular economy principles can help reduce consumption and waste. By choosing durable and eco-friendly products, practicing repair and reuse, and adopting sharing and collaborative consumption models, individuals can reduce their environmental footprint. Nature-based solutions can be integrated into circular economy practices, such as using recycled materials in construction or promoting product life extension through repair and refurbishment.[43]

Environmental education and awareness: Promoting environmental education and awareness can empower individuals to make informed choices and adopt sustainable lifestyles. Nature-based solutions can serve as educational platforms, providing opportunities for people to connect with and learn about ecosystems, fostering a sense of environmental responsibility.[44]

Policy and Governance for sustainability

Nature-based solutions (NbS) requires effective policy governance for sustainability. Policy frameworks and governance mechanisms play a crucial role in promoting and supporting the implementation of nature-based solutions and ensuring their long-term success. Here are some examples of how policy governance can be harnessed to facilitate the integration of nature-based solutions for sustainability, along with relevant references:

National biodiversity strategies and action plans (nbsaps): National Biodiversity Strategies and Action Plans provide policy frameworks that guide the conservation and sustainable use of biodiversity, including the integration of nature-based solutions. These plans help set targets, identify priority areas for conservation, and outline measures for mainstreaming NbS into various sectors.

Protected area management and governance: Effective governance and management of protected areas are crucial for the conservation and sustainable use of ecosystems. Policies and regulations can support the establishment and management of protected areas, ensuring their ecological integrity and promoting sustainable practices within their boundaries.

Climate change adaptation and mitigation policies: Integration of nature-based solutions into climate change policies is essential for achieving adaptation and mitigation goals. Policy frameworks should recognize the role of ecosystems in climate change resilience and provide incentives and support for the implementation of nature-based solutions, such as ecosystem restoration and climate-smart agriculture.

Sustainable Development Goals (SDGs): The Sustainable Development Goals provide a global framework for sustainable development, including targets related to biodiversity conservation, sustainable land use, and climate action. Policies aligned with the SDGs can integrate nature-based solutions to address multiple environmental and social challenges.

Effective policy governance is crucial for mainstreaming nature-based solutions, ensuring collaboration among various stakeholders, providing financial incentives, and creating an enabling environment for their implementation.[45]

Conclusion

In conclusion, nature-based solutions have emerged as a powerful approach for addressing the complex and interconnected challenges facing our planet. By harnessing the power of ecosystems, we can not only mitigate climate change but also promote sustainable development, enhance resilience, and improve human well-being.

Throughout this article, we have explored the numerous benefits and applications of nature-based solutions. From reforestation and habitat restoration to the implementation of green infrastructure and the protection of coastal ecosystems, these solutions offer a wide range of opportunities to create a more sustainable and resilient future.

Nature-based solutions provide a holistic approach that recognizes the interdependence of ecosystems and human society. They offer multiple co-benefits, including carbon sequestration, biodiversity conservation, water purification, and natural hazard mitigation. Moreover, they can enhance social and economic development by creating green jobs, improving food security, and supporting community engagement and empowerment.

However, realizing the full potential of nature-based solutions requires concerted efforts from governments, organizations, communities, and individuals. We need to prioritize the conservation and restoration of natural habitats, integrate nature-based solutions into urban planning and infrastructure development, and invest in research and innovation.

Furthermore, it is crucial to ensure equitable and inclusive implementation of nature-based solutions, particularly in vulnerable and marginalized communities. By engaging local stakeholders, respecting indigenous knowledge and rights, and fostering partnerships across sectors, we can maximize the effectiveness and sustainability of these solutions.

As we face unprecedented challenges such as climate change, biodiversity loss, and resource depletion, nature-based solutions offer a ray of hope. They remind us that nature is not just a victim but also a powerful ally in building a resilient and sustainable future. By harnessing the power of ecosystems, we can create a harmonious coexistence between nature and society, where the well-being of both thrives.

In conclusion, nature-based solutions provide a pathway towards a future Earth where humans and nature coexist in harmony, allowing us to tackle the pressing environmental challenges while promoting sustainable development and enhancing the quality of life for all. It is imperative that we embrace and invest in nature-based solutions to create a resilient and thriving planet for generations to come.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

References

1. Colding J, Barthel S. Urban green spaces and mental health: Acting on the evidence. *The Lancet Planetary Health*. 2017;1(3):e81–e82.
2. United Nations. Transforming our world: The 2030 Agenda for Sustainable Development. 2015.
3. Convention on Biological Diversity. National biodiversity strategies and action plans: Best practices for implementation. Secretariat of the Convention on Biological Diversity. 2015.
4. IPCC. Climate change 2014: Synthesis report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC. 2014.
5. Dudley N. Guidelines for applying protected area management categories. IUCN. 2008.
6. Gomez–Baggethun E, Gren Å, Barton DN, et al. Urban ecosystem services. In Urbanization, biodiversity and ecosystem services: Challenges and opportunities. Springer. 2013:175–251.
7. Rai V, Byrne J, Melaina M. Addressing barriers to the adoption of plug–in electric vehicles in urban areas. *Transportation Research Part D: Transport and Environment*. 2017;55:322–333.
8. Benedict MA, McMahon ET. Green infrastructure: Linking landscapes and communities. Island Press; 2006.
9. Haddad NM, Brudvig LA, Clobert J, et al. Habitat fragmentation and its lasting impact on Earth's ecosystems. *Science advances*. 2015;1(2):e1500052.
10. Lazcano C, Arnold J, Shigaki F. Improving safety and reducing waste in organic waste composting: Applying innovative technologies and good practices. *Waste management*. 2010;30(9–10):1737–1745.
11. Vymazal J. Constructed wetlands for wastewater treatment: Five decades of experience. *Environmental science & technology*. 2014;48(19):10249–10256.
12. Cunningham SD, Berti WR, Huang JW. Phytoremediation of contaminated soils. *Trends in biotechnology*. 1995;13(9):393–397.

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DOI: 10.15406/mojes.2023.08.00295

13. Côté P, Larson B. Sustainable forest management. Springer; 2018.
14. Chazdon RL, Brancalion PHS, Laestadius L. Beyond hectares: Four principles to guide reforestation in the context of tropical forest and landscape restoration. *Restoration Ecology*. 2016;24(4):353–358.
15. Jose S. Agroforestry for ecosystem services and environmental benefits: An overview. *Agroforestry Systems*. 2009;76(1):1–10.
16. Cullen–Unsworth LC, Nordlund LM, Paddock J, et al. Seagrass meadows globally as a coupled social–ecological system: Implications for human wellbeing. *Marine Pollution Bulletin*. 2019;145:46–56.
17. Brauman KA, Daily GC, Duarte TK, et al. The nature and value of ecosystem services: An overview highlighting hydrologic services. *Annual Review of Environment and Resources*. 2007;32:67–98.
18. Bonan GB. Forests and climate change: Forcings, feedbacks, and the climate benefits of forests. *Science*. 2008;320(5882):1444–1449.
19. Mitsch WJ, Bernal B, Nahlik AM, et al. Wetlands, carbon, and climate change. *Landscape Ecology*. 2013;28(4):583–597.
20. Smith P, Bustamante M, Ahammad H, et al. Agriculture, forestry and other land use (AFOLU). Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press; 2014:811–922.
21. Duarte CM, Losada IJ, Hendriks IE, et al. The role of coastal plant communities for climate change mitigation and adaptation. *Nature Climate Change*. 2013;3(11):961–968.
22. Orsini F, Gasperi D, Marchetti L, et al. Exploring the production capacity of rooftop gardens (RTGs) in urban agriculture: The potential impact on food and nutrition security, biodiversity and other ecosystem services in the city of Bologna. *Food Security*. 2014;6(6):781–792.
23. Fuller D, Gauvin L, Kestens Y. Inside the 'Black Box'of walking: A decomposition of the effects of built environments and neighborhood self–selection on walking. *International Journal of Environmental Research and Public Health*. 2013;10(9):3933–3952.
24. Grimm NB, Faeth SH, Golubiewski NE, et al. Global change and the ecology of cities. *Science*. 2008;319(5864):756–760.
25. Chawla L, Cushing DF, Education for strategic environmental behavior. *Environmental Education Research*. 2007;13(4):437–452.
26. McKinley DC, Miller–Rushing AJ, Ballard HL, et al. Citizen science can improve conservation science, natural resource management, and environmental protection. *Biological Conservation*. 2017;208:15–28.
27. Fien J, Yencken D, Sykes H, et al. Education for sustainability in the primary curriculum: A guide for teachers. Curriculum Corporation. 2008.
28. Kollmuss A, Agyeman J. Mind the gap: Why do people act environmentally and what are the barriers to pro–environmental behavior? *Environmental education research*. 2002;8(3):239–260.
29. Benyus J. Biomimicry: Innovation inspired by nature. Harper Collins; 2009.
30. Moloney CL, Hobbs RJ. Nature–based solutions for managing urban ecosystems and biodiversity. *Ecosystem Health and Sustainability*. 2017;3(1):e01255.
31. Rey Benayas JM, Newton AC, Diaz A, et al. Enhancement of biodiversity and ecosystem services by ecological restoration: A meta–analysis. *Science*. 2009;325(5944):1121–1124.
32. Kummu M, Guillaume JH, de Moel H, et al. The world's road to water scarcity: Shortage and stress in the 20th century and pathways towards sustainability. *Scientific Reports*. 2016;6:38495.
33. Mitsch WJ, Gosselink JG. Wetlands. 5th edn. John Wiley & Sons; 2015.
34. Palmer MA, Filoso S, Fanelli RM. From ecosystems to ecosystem services: Stream restoration as ecological engineering. *Ecological Engineering*. 2014;65:62–70.
35. Wong THF, Fletcher TD, Duncan HP. A review of the benefits and limitations of stormwater source control measures. *Science of the Total Environment*. 2010;408(23):4911–4920.
36. Bruijnzeel LA. Hydrological functions of tropical forests: Not seeing the soil for the trees? *Agriculture, Ecosystems & Environment*. 2004;104(1):185–228.
37. Cabello–Eras JJ, Aymerich IF, Barrios–Padura Á, et al. Evaluation of green roofs and solar photovoltaic (PV) systems integration: A systematic review. *Energies*. 2020;13(7):1561.
38. Ochoa LF, Hernandez–Molina G. Benefits of integrating smart grids and renewable energy systems. *IET Renewable Power Generation*. 2012;6(5):384–391.
39. Kibert CJ. Sustainable construction: Green building design and delivery. 4th edn. John Wiley & Sons; 2016.
40. Geissdoerfer M, Savaget P, Bocken NM, et al. The circular economy – a new sustainability paradigm? *Journal of Cleaner Production*. 2017;143:757–768.
41. HLPE. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. High–Level Panel of Experts on Food Security and Nutrition, Committee on World Food Security. 2019.
42. Shaheen S, Cohen A, Chung D. North American carsharing: 2019 outlook. Research report. UC Berkeley: Transportation sustainability Research Center. 2019.
43. Bocken NM, Short SW, Rana P, et al. A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*. 2014;65:42–56.
44. Disinger JF. Environmental education: Purpose, methods and techniques. *Environmental Education Research*. 2017;23(6):801–812.
45. Burkhard B. Nature–based solutions: From concepts to practice. Springer; 2019.

Citation: Keny JNP. Nature-based solutions for future earth: harnessing the power of ecosystems. *MOJ Eco Environ Sci.* 2023;8(6):218–223.
DOI: 10.15406/mojes.2023.08.00295