Introduction

Nature-Based Solutions (NbS) harness ecosystems to tackle climate change, food security, and disaster risks while enhancing biodiversity and human well-being. By protecting, managing, and restoring natural systems like forests, mangroves, and peatlands, NbS mitigate greenhouse gas emissions, build resilience against climate impacts, and improve water security, soil health, and livelihoods. A 2020 IUCN report suggests NbS could reduce the intensity of climate hazards by 26% by 2050, positioning them as critical for global climate and nature goals.

Roles in Climate Change

1. Mitigation

NbS capture and store carbon dioxide through ecosystems like forests, peatlands, and mangroves. Mangroves, for instance, can sequester up to 4 tons of CO_2 per hectare annually, per Donato et al. (2018), though earlier estimates cited 1.5 tons/ha/year. According to the IPCC (2019), NbS and the land sector could contribute up to 30% of the climate mitigation needed by 2050 to meet Paris Agreement objectives. Protecting these ecosystems prevents emissions from deforestation or degradation, while sustainable biomaterials, such as bamboo or timber in construction, replace carbon-intensive alternatives like concrete. Agroforestry, integrating trees into farmland, further boosts carbon storage in Malaysia.

2. Adaptation

NbS bolster resilience against climate impacts like floods, droughts, heatwaves, and sea-level rise. Coastal ecosystems, such as mangroves and coral reefs, act as natural barriers, buffering storm surges and erosion. The Netherlands' "Room for the River" project, using wetlands to manage floods, offers a global example. In Malaysia, forests and wetlands

regulate water flow, reducing flood and landslide risks. Urban greening initiatives, like green roofs and rain gardens, mitigate urban heat island effects through shade and evapotranspiration while managing stormwater.

3. Biodiversity and Socioeconomic Benefits

NbS preserve habitats essential for ecosystem stability and biodiversity, supporting species like Malaysia's orangutans, hornbills, and proboscis monkeys. They sustain livelihoods through sustainable fisheries, agriculture, and eco-tourism. Additionally, NbS improve public health by enhancing air and water quality and providing green spaces for recreation and mental well-being, fostering equitable economic opportunities.

Examples of NbS

1. Mangrove Restoration and Protection

Mangroves, storing up to four times more carbon per hectare than tropical rainforests, shield coastlines from erosion and storm surges. Malaysia, with over 500,000 hectares of mangroves, has lost 20% since the 1980s due to aquaculture and development. Community-led replanting in Kedah and Perak has restored over 1,000 hectares, while Indonesia's mangrove restoration in Sumatra provides a regional model.

Impact: Enhances coastal resilience, sequesters significant carbon, protects fisheries and migratory bird habitats, and supports local economies.

2. Peatland Restoration

Peatlands are among the world's largest terrestrial carbon stores. Malaysia's Sustainable Management of Peatland Ecosystems (SMPEM) project restores peatlands by rewetting—raising water levels to restore natural hydrology—and blocking drainage canals, reducing emissions by an estimated 100,000 tons of CO_2 annually in pilot areas. This prevents fires and re-establishes hydrological functions.

Impact: Reduces CO_2 emissions, mitigates transboundary haze, regulates water flow to prevent floods and droughts, and conserves unique biodiversity.

3. Forest Conservation and Reforestation

Malaysia's Central Forest Spine (CFS) project reconnects fragmented forests, creating ecological corridors for wildlife like orangutans. Since 2021, Sabah and Sarawak have planted 47.5 million and 35 million trees, respectively, under REDD+ frameworks. Collaborations between large Malaysian corporations and the Malaysia Forest Fund aim to conserve rainforests, potentially reducing emissions by 200,000 tons of CO_2 annually. Thailand's community forestry programs complement these efforts regionally.

Impact: Enhances ecosystem connectivity, supports biodiversity, sequesters carbon, provides clean air and water, protects against erosion, and promotes eco-tourism and

sustainable livelihoods.

4. Urban Green Spaces

Urban parks, green roofs, permeable pavements, and riverbank rehabilitation, like Kuala Lumpur's Taman Tugu park, help cities adapt to climate change. Community gardens and pocket parks are expanding, though space constraints pose challenges.

I**mpact:** Lowers urban temperatures, manages stormwater, improves air quality, captures carbon, and enhances public health and well-being.

Challenges and Considerations

1. Land-Use Conflicts and Governance

Competing demands from agriculture (e.g., palm oil plantations, which replaced 20% of Malaysia's peatlands since 2000), urban development, and infrastructure prioritize economic gains over NbS. Fragmented policies across forestry, water, and disaster management hinder cohesive implementation. A national NbS task force could improve coordination across ASEAN and Malaysia.

2. Ensuring Long-Term Carbon Storage

Illegal logging, fires, and development pressures threaten forest and peatland integrity. Satellite monitoring and community-led enforcement, as seen in Sabah's indigenous forest monitoring, ensure permanence and track carbon benefits.

3. Financing and Incentives

NbS struggle with funding, as budgets favor short-term growth. Green bonds and private-sector partnerships, like PETRONAS's conservation efforts, offer solutions, but navigating REDD+ and carbon markets remains complex.

4. Scientific Data and Ecosystem Resilience

Limited data on ecosystem services and cost-benefits deters investment. Regional research collaborations and open-access platforms could address this. Climate threats like rising sea levels require adaptive management, such as tailored mangrove restoration techniques.

5. Community Engagement and Equity

Unclear land tenure and resource dependence complicate community involvement. Equitable benefit-sharing, as demonstrated by indigenous-led projects in Sabah, and transparent governance are essential to avoid marginalization.

Conclusion

Nature-Based Solutions are indispensable for addressing climate change, offering sustainable strategies for mitigation, adaptation, and biodiversity conservation. Malaysia's mangrove restoration, peatland rewetting, forest conservation, and urban greening showcase their transformative power. To unlock their full potential, policymakers must establish cross-sectoral NbS strategies, secure innovative financing like green bonds, and invest in robust monitoring systems. Communities, businesses, and governments should collaborate to support local projects, ensuring a resilient, biodiverse, and equitable future.

References:

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