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Resilience of Ecosystem and Ecosystem Services Outlook

Resilience for All: Enabling transformative implementation

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8th Asia-Pacific Climate Change Adaptation Forum

Resilience Outlook

Resilience of Ecosystems and Ecosystem Services

Prepared by

UNEP Regional Office for Asia and the Pacific

and

IUCN Regional Office for Asia

This Outlook is developed building on the Nature-based Resilience Outlook, co-authored by IUCN and UNEP for the 7th APAN Forum.

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Summary

The Asia-Pacific region is particularly vulnerable to the impacts of climate change. Its diverse ecosystems, which provide crucial services for billions of people, are at risk due to intensifying climate change impacts that compound to other non-climate drivers such as pollution and biodiversity loss. The region's high population density and reliance on ecosystem services further exacerbate these challenges putting communities at risk. There is therefore an urgent need to catalyse transformative adaptation in the region.

This Outlook, developed under the Ecosystems and Ecosystem Services Resilience stream of the 8th Asia-Pacific Climate Change Adaptation (APAN) Forum, aims to provide a background for the Forum's discussions. It is structured around five key enablers: 1. Policy and Governance, 2. Planning and Programming, 3. Science and Assessment, 4. Technologies and Practices, 5. Finance and Investment. At the same time, the Outlook seeks to shine a spotlight on select key ecosystems in the region and underscore the opportunities to support and catalyse transformative adaptation actions.

I. Current Status of Ecosystems and Ecosystem Services Resilience in the Asia-Pacific Region

1. Background

Ecosystems, along with the services they provide, play a fundamental role in sustaining life on Earth, delivering vital benefits to people such as climate regulation, water management, and food provision. While ecosystems possess the capacity to enhance human resilience through their functions and services, they concurrently face threats from climate change, pollution and biodiversity loss. Therefore, it is imperative to restore or safeguard ecosystems to enhance their resilience while continuing to develop solutions for climate change and addressing non-climate drivers of ecosystem loss.

Ecosystem services are defined as the benefits obtained from ecosystems, and these include, for example, the provision of essential resources like food and water, as well as regulatory functions flood control, disease management, and climate regulation[1]. Further, ecosystems provide supporting services including nutrient cycling. Beyond supporting human well-being, these services act as a robust buffer against climate change impacts by regulating water flow, offering natural defenses against storms. Ecosystem services can also significantly contribute towards climate change mitigation: conservation, restoration, and management of ecosystems potentially account for up to 30% of the mitigation needed to limit warming to below 2°C[2].

In 2016, members of the International Union for Conservation of Nature (IUCN) adopted their first official definition of Nature-based Solutions (NbS): "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" [3]. Since its introduction, this definition has been commonly used by IUCN members, including governments and the United Nations system. In 2022, during the Fifth Session of the United Nations Environment Assembly (UNEA-5), a multilaterally agreed definition of NbS[4] was adopted (as seen in Table 1), recognising and further emphasising the importance of ecosystems and the services they provide to human wellbeing. Further, the recognition by the UN General Assembly and the UN Human Rights Council of the human right to a clean, healthy, and sustainable environment paves the way for advancing rights-based approaches to environmental protection and addressing human rights implications of climate change, biodiversity loss and pollution.

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[1] Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

[2] Griscom, B.W. et al., 2017. Natural climate solutions. Proceedings of the National Academy of Sciences, 114(44), 11645-11650. https://doi.org/10.1073/pnas.1710465114.

[3] IUCN. 2016. Resolution 69 on Defining Nature-based Solutions (WCC-2016-Res-069). IUCN Resolutions, Recommendations and Other Decisions. 6-10 September 2016. World Conservation Congress Honolulu, Hawai'i, USA.

[4] United Nations Environment Assembly of the United Nations Environment Programme. 2022. Resolution, Nature-based Solutions supporting Sustainable Development. Fifth session Nairobi (hybrid), 22 and 23 February 2021 and 28 February–2 March 2022.

Nature-based Solutions (NbS): 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, resilience and biodiversity benefits (UNEA, 2022)[4].

Ecosystem-based Adaptation (EbA): Use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change (SCBD, 2009)[5].

Forest Landscape Restoration (FLR): A process that aims to regain ecological functionality and enhance human well-being in deforested or degraded landscapes.

Table 1. Key definitions

2. Resilience of Ecosystems and Ecosystem Services in Asia and the Pacific

The Asia-Pacific region harbors some of the most diverse ecosystems on Earth, ranging from the world's highest mountain peaks to rainforests and plateaus, and low-lying coastal areas and islands to the deepest oceanic trench. Notably, the region has a high number of endemic species, and it contains 17 of the 36 global biodiversity hotspots[6]. These rich ecosystems and ecosystem services are essential for the over 4 billion people residing in the region, providing food, freshwater, livelihoods and a buffer against climate impacts. This biodiversity has also contributed to the region's rapid economic growth and development, characterised by some of the highest rates of economic expansion and urbanisation globally. As a result, there has been a marked decline in poverty, coupled with significant improvements in livelihoods, income levels, health, and education. Yet, this economic growth has exerted pressure on the region's ecosystems and biodiversity. Among all global regions, the Asia-Pacific has witnessed the steepest decline in ecosystem intactness, which has fallen to 64% and will decline further under prevailing conditions.[7] At the same time, existing policies are not sufficient to promote and support the sustainable utilisation of ecosystems. For example, only 13.2% of Asia's terrestrial area is under protection, which falls short of the 17% goal of the Aichi Target 11[8].

[5] SCBD. 2009. Connecting biodiversity and climate change mitigation and adaptation: Report of the second ad hoc technical expert group on biodiversity and climate change. Technical Series No. 41. Montreal: Secretariat of the Convention on Biological Diversity.

[6] IPBES. 2018. The IPBES regional assessment report on biodiversity and ecosystem services for Asia and the Pacific. Karki, M., Senaratna Sellamuttu, S., Okayasu, S., and Suzuki, W. (eds). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany.

[7] UN ESCAP. 2022. Protecting our Planet through Regional cooperation and Solidarity in Asia and the Pacific, p.17.

[8] Farhadinia, M.S. et al. 2022. Current trends suggest most Asian countries are unlikely to meet future biodiversity targets on protected areas. *Commun Biol* 5, 1221. https://doi.org/10.1038/s42003-022-04061-w

The Asia-Pacific region is also one of the most vulnerable areas to climate change disasters. According to the 2023 Asia-Pacific Disaster Report[9], Asia experienced 141 weather, climate and water-related disasters in 2022, which resulted in the loss of over 7,500 lives, affected 64 million people, and caused $36 billion in economic damage. The impacts of climate change intensifying, especially when combined with non-climate drivers such as pollution, biodiversity and habitat loss, further jeopardising ecosystems and ecosystem services. The increased ecosystem vulnerability and imbalances in the flow of ecosystem services will adversely affect human well-being and increase societal vulnerability through lowered food and freshwater availability and reduced protections against natural disasters and climate change-induced hazards. For example, clearing mangroves for development purposes can cripple coastal communities' livelihoods and food security as mangrove-dependent fish populations disappear, and leave coastal areas exposed to storms, flooding, and erosion. Ecosystem vulnerability can have different scales of impacts across different groups, influenced by factors such as gender, disability, age, ethnicity and socio-economic status. Such impacts often exacerbate existing inequalities and vulnerabilities. For example, women in Asia-Pacific are highly dependent on natural resources for their livelihoods, and as such, they face heightened risks when these resources become scarce due to ecosystem vulnerabilities, undermining their capacity to sustain their families and gain self-reliance[10]. Moreover, climate change-induced ecosystem vulnerabilities and disasters can also contribute to conflicts, which have been observed to increase negative coping strategies and proliferate gender-based violence[11].

3. Three Ecosystems in Focus

a. Oceans, Coasts and Island Ecosystems

Healthy ocean ecosystems provide oxygen and food, regulate the climate, nutrient and water cycle, and contribute to coastal livelihoods and economies. The Asia-Pacific region consists of vast marine and coastal areas that harbor some of the richest marine biodiversity in the world. These ecosystems are crucial in supporting food and livelihoods for millions of people. For example, in 2020, 49.4 million people in Asia were employed in the fisheries and aquaculture sector[12] and in the Pacific, people rely on reef and pelagic fish for food security and income. Ocean and coastal ecosystems also provide essential climate benefits. Mangrove forests and coral reefs provide protection to coastal areas during cyclones and storm surges by mitigating the impact of the waves. In addition, blue carbon ecosystems, including mangrove forests, seagrass meadows, and freshwater ecosystems such as

[9] UN ESCAP. 2023. Seizing the moment: targeting transformative disaster risk resilience. Asia-Pacific Disaster Report. 2023.

[10] UN Women. 2022. Women and the Environment. An Asia-Pacific Snapshot. https://data.unwomen.org/sites/default/files/documents/Publications/APRO_Women-environment-snapshot.pdf

[11] Castañeda Camey, I., Sabater, L., Owren, C. and Boyer, A.E. 2020. Gender-based violence and environment linkages: The violence of inequality. Wen, J. (ed.). Gland, Switzerland: IUCN.

[12] FAO. 2022. The State of World Fisheries and Aquaculture https://www.fao.org/3/cc0461en/online/sofia/2022/fisheries-aquaculture-employment.html

marshes and peatlands that capture carbon, play a key role in mitigating greenhouse gas emissions[13].

Vulnerability to climate change

The oceans, coasts and island ecosystems are under pressure from pollution, overfishing and habitat destruction. Climate change impacts are putting further pressure on ecosystems and the services they provide, for example, sea level rise, intensifying storms and coastal flooding will lead to coastal salinification, habitat erosion, biodiversity loss, and ocean warming, and deoxygenation and acidification are affecting marine life causing mobile species to shift their ranges. These climate impacts will pose high risks to the communities in the region that depend on marine ecosystems for food and socio-economic benefits[14]. For example, key tuna species in the Pacific are expected to shift their migration patterns, affecting numerous Pacific island countries that depend on these fish stocks for nutrition and economic growth[15]. Sea level rise is causing loss and damage to homes, cultural and ancestral sites, indigenous knowledge, agricultural land and infrastructure. Such displacements profoundly impact communities' identities, heritage and sense of place. In the Pacific islands, rising sea levels also have serious legal implications in terms of territorial rights for land and sea. Increasingly extreme tropical storms and cyclones are also causing havoc in coastal areas. In Fiji, the 2016 Cyclone Winston killed 44 people, left 131,000 homeless and wiped out over 30% of the country's GDP. Similarly, the 2020 Cyclone Amphan, one of the strongest cyclones recorded, killed 90 and displaced 4.9 million in Bangladesh and India, causing an estimated $13.2 billion in damage.

Resilience building

Due to the interconnected nature of oceans and marine ecosystems, many of the key issues, including climate change impacts, extend across national borders and beyond. The recently adopted landmark agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction will help protect 30% of the world's oceans by 2030. Another key approach is the cross-cutting blue economy that aims to develop a long-term strategy for the sustainable use of ocean resources while improving human well-being and social equity and preserving the environment. Because the health of marine ecosystems is the foundation of the blue economy, this approach serves as a crucial vehicle for integrating ecosystem-based approaches into economic activities and concurrently promoting the resilience of marine ecosystems.

UNEP Regional Seas programmes, i.e., the Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region (NOWPAP) and the Coordinating Body on the Seas of East Asia (COBSEA) are the primary regional mechanisms for conservation of the marine and coastal environment that bring together countries for the protection and sustainable development of marine and coastal

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[13] Macreadie, P.I. et al. 2021. Blue carbon as a natural climate solution. *Nat Rev Earth Environ* 2, 826–839. https://doi.org/10.1038/s43017-021-00224-1

[14] Tigchelaar, M., Cheung, W.W.L., 2021. Mohammed, E.Y. *et al.* Compound climate risks threaten aquatic food system benefits. *Nat Food* 2, 673–682. https://doi.org/10.1038/s43016-021-00368-9

[15] Bell, J.D. et al. 2021. Pathways to sustaining tuna-dependent Pacific Island economies during climate change. *Nat Sustain* 4, 900–910. https://doi.org/10.1038/s41893-021-00745-z

ecosystems. The South Asian Seas Programme and Noumea Convention for the protection of natural resources and environment in the South Pacific, coordinated by the Secretariat for the Pacific Regional Environment Programme (SPREP) are also important mechanisms. Other examples include the Bay of Bengal Large Marine Ecosystem, run by Food and Agriculture Organization of the United Nations (FAO) together with IUCN to contribute to sustainable management of fisheries, marine living resources and their habitats in the Bay of Bengal region.

Useful lessons for scaling up can also be obtained from past partnership-based regional initiatives promoting investment in coastal ecosystem conservation for sustainable development, such as Mangroves for the Future (MFF). MFF provided a platform for addressing challenges to coastal ecosystem and livelihood issues with the goal to promote an integrated approach to coastal management and build the resilience of ecosystem-dependent coastal communities[16]. On a national level, numerous countries are harnessing the power of nature to strengthen the resilience of people and ecosystems to climate impacts in coastal areas. For example, a project in Bangladesh aims to mainstream and scale up NbS in 22 coastal towns in the low-lying 'upazilas' to help communities adapt to climate change[17]. Meanwhile, in Fiji, vetiver grass is employed as a measure against coastal erosion, safeguarding coasts as part of an EU-funded project.

b. Forest Ecosystems

The forests in Asia-Pacific together account for around 20% of global forests and the region also harbors the most extensive mangrove forest areas in the world. These ecosystems are responsible for primary production, providing clean air and water, food, timber, and other key resources to people. In addition, forest ecosystems regulate climate, and water and nutrient cycle, purify air and water, and help mitigate flooding and erosion. Terrestrial forests are also home to most of the terrestrial biodiversity, including plants, fungi, and both vertebrate and invertebrate species. As "carbon sinks", forests' role in climate change mitigation is vital. However, forests play a key role in climate change adaptation by providing significant adaptation benefits such as soil stabilisation, water management, and temperature and heat wave mitigation. Further, forests are crucial for communities' adaptive capacity because their local ecosystem services reduce societal vulnerability and improve communities' resilience.

Vulnerability to climate change

Forests and the rest of the terrestrial landscapes have evolved and shown remarkable resilience to climate changes and natural disturbances for millions of years. However, the current rate and magnitude of climate change pose major challenges to forest ecosystems globally, including in Asia-Pacific. Climate change impacts, such as rising temperature, shifting precipitation patterns, and the increasing frequency and intensity of extreme weather events combined with elevated carbon dioxide levels can result in altered growth conditions, disrupted ecological balances, and increased vulnerability to pests and diseases. Climate change related challenges are often exacerbated by other anthropogenic stressors, such as deforestation, illegal logging, biodiversity loss, forest fires, fragmentation, and pollution, hindering their ability to adapt to climate change. The unprecedented rates of both climate

[16] https://www.iucn.org/news/asia/201810/mangroves-future-video-a-look-back

[17] https://gca.org/news/gca-and-adb-to-scale-up-nbs-for-climate-adaptation-in-bangladesh/

change and deforestation currently outpace the adaptive capacity of forests. This is exacerbated by the possibility that the tipping point of forest ecosystems, i.e. the potential loss of their ability to bounce back after disturbances and to attenuate the impacts of climate change, is near. It has been documented that in the Bornean forest ecosystems, major extreme climate events, such as the 1997-98 El Nino drought, temporarily turned Borneo's forests from a carbon sink into a carbon source, suggesting that more frequent and intense extreme events would bring catastrophic effects to the forests and their climate regulating function[18]. The same study also indicated that forests located close to a logging site or oil palm plantation released more carbon than elsewhere (i.e., so-called edge effect) because these regions experience a higher rate of tree death, highlighting the importance of maintaining undisturbed primary forests and protection against further fragmentation.

Resilience building

Forest adaptation measures are crucial for enhancing the resilience of forest ecosystems and local communities, and for ensuring the continuation of ecosystem services. Given the importance of intact landscapes for improving the resilience of forests, conserving and safeguarding primary forests from deforestation and fragmentation are key. An example of utilisation of NbS for forest ecosystems is forest and landscape restoration (FLR), the ongoing process of regaining ecological functionality and enhancing human well-being across deforested or degraded forest landscapes. An IUCN study showed that combining mitigation and adaptation in FLR will achieve concrete co-benefits and there are already effective synergies that FLR offers at the country level that need to be scaled up worldwide[19]. An example of this is the use of agroforestry techniques for FLR. Agroforestry focuses on improving crop and pasture land management with an emphasis on intercropping with trees, with the aim of managing forest goods and services. It not only diversifies the farm's production, but improves soil health and enhances water management. While agroforestry covers between 24-78% of agricultural land in Asia[20], further efforts are needed to scale up both the quantity and quality of agroforestry in the region.

In urban settings, deploying FLR by planting trees and urban forestry is crucial to help mitigate the urban heat island effect, improve air quality, sequester carbon, and enhance stormwater retention. Such initiatives encompass 'Sponge Cities' and parks, such as the Centenary Park in Bangkok[21] that capture rainwater preventing flooding. Cities across Asia-Pacific are also joining regional or global alliances on the topic of urban forestry, such as Cities4Forests[22]. Another important adaptation measure is climate-smart forest management. These include promoting native tree species, reducing vulnerability to pests and diseases, and identifying ways to better withstand more intense and frequent droughts. Such climate-smart practices should be mainstreamed in forest conservation, restoration and sustainable forest

[18] Qie, L. et al. 2017. Long-term carbon sink in Borneo's forests halted by drought and vulnerable to edge effects. *Nat Commun* 8, 1966. https://doi.org/10.1038/s41467-017-01997-0

[19] Baig, S., Barrow, E. G. C., Kumar, C., Rizvi, A.R. 2015. Synergies between climate mitigation and adaptation in forest landscape restoration. IUCN. https://portals.iucn.org/library/node/45203

[20] https://forestsnews.cifor.org/78652/asia-and-agroforestry-a-systematic-approach-to-policies-and-practices

[21] https://www.futurarc.com/project/chulalongkorn-university-centenary-park/

[22] https://cities4forests.com/about/member-cities/

management across different forest uses. Engagement with local communities must be strengthened to ensure the sustainability of the adaptation efforts, and indigenous peoples often have traditional knowledge of forest management that is essential for refining adaptation measures.

Finally, more research is needed to better understand the impacts of climate change on forest ecosystems (e.g., on the tipping points) and to improve adaptation measures. The tools for monitoring various stressors to forest ecosystems such as deforestation, forest fires, and extreme weather, can be further refined and serve as inputs to the development of effective early warning systems.

c. Mountains and High-Altitude Ecosystems

The Asia-Pacific region is home to some of the world's highest mountains including the Pamir, Kunlun, Tian Shan, Hindu-Kush, and the Himalayas that harbors Mount Everest, the highest peak on Earth. These mountain areas are characterised by their vast glaciers and snow cover with the Hindu-Kush Himalayan (HKH) ice sheet containing the largest amount of snow and ice after the Arctic and the Antarctic. Originating from these glaciers are 12 major rivers in the region[23], including Brahmaputra, Ganges, Indus, Irrawaddy, Mekong, Yangtze and Yellow Rivers, which directly and indirectly supply water and ecosystem services, underpinning the livelihoods of almost 1.9 billion[28] people both upstream and downstream. Globally, more than 3 billion people depend on the food produced in the river basins of this region[24]. Furthermore, These mountain ecosystems are some of the most ecologically diverse areas in the world[25] hosting unique flora and fauna. The HKH alone hosts four of the 35 global biodiversity hotspots, sheltering over 35,000 species of plants[26], including 10,000 species of high medicinal value[26] .

Vulnerability to climate change

The mountains, glaciers and high-altitude areas in Asia are highly vulnerable to climate change impacts, including melting glaciers, landslides, changing precipitation patterns, and increased frequency of extreme weather events that affect both human and natural systems. Rising temperatures are accelerating permafrost shrinkage and snow and glacier melting leading to the retreat, thinning and significant reduction of glacier and snow cover in the region. For example, the HKH is predicted to lose up to two-thirds of its glaciers by the end of the century[27]. In addition, increasing temperatures are altering the structure and functions of

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[23] ICIMOD. 2023. Water, ice, society, and ecosystems in the Hindu Kush Himalaya: An outlook. (P. Wester, S. Chaudhary, N. Chettri, M. Jackson, A. Maharjan, S. Nepal, & J. F. Steiner [Eds.]). ICIMOD. https://doi.org/10.53055/ICIMOD.1028

[24] Wester, P., Mishra, A., Mukherji, A. and Shrestha, A.B., 2019. The Hindu Kush Himalaya assessment: mountains, climate change, sustainability and people, p. 627. Springer Nature.

[25] Myers, N. et al. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403, 853–858. https://doi.org/10.1038/35002501

[26] Xu, J., Badola, R., Chettri, N. et al. 2019. Sustaining biodiversity and ecosystem services in the Hindu Kush Himalaya. In: Wester P, et al. (eds.), *The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People*. Cham: Springer International Publishing, 2019: 127–65.

[27] IPCC. 2019. Special Report on the Ocean and Cryosphere in a Changing Climate. Intergovernmental Panel on Climate Change. https://www.ipcc.ch/srocc/

ecosystems by pushing lower-elevation species' ranges higher up leading to the decline and extinctions of cold-adapted or snow-dependent species that lose their habitats. Additionally, glacier melting has significant implications for water availability, as it can disrupt river systems increasing the risk of floods and landslides and affecting the people who depend on these water resources for livelihoods. The release of toxins from glacial melting is also predicted to affect human health, particularly in areas where glacial melt is used for drinking water[28]. A recent report by ICIMOD[25] highlights the significant impacts of climate change on ecosystems, ecosystem services, and people in the HKH region as they are experiencing unprecedented and largely irreversible changes in its cryosphere due to climate change. These changes are affecting mountain communities and downstream communities, infrastructure, and economies that are at risk from landslides, glacial lake outburst flooding and reduced freshwater resources.

Resilience building

For mountain ecosystems that are vulnerable to multiple hazards with transboundary and cascading impacts, there is a need for a holistic approach to building resilience. Regional cooperation across and between mountainous areas is therefore critical in moving towards establishing food, energy, and water security to enhance climate resilience and ecosystem services within the mountains and downstream areas. Comprehensive monitoring of climate change impacts on biodiversity will enable better management of evolving ecosystem challenges. Leveraging this knowledge, transformative changes (i.e., transitioning to green, inclusive and resilient practices and nature-based solutions) can be implemented for key sectors, such as agriculture, forest, water, tourism and energy.

Early warning systems (EWS), tailored to the specific needs of mountain communities, are critical to alerting them to potential climate-related hazards, such as floods and landslides. By fostering cross-border partnerships and implementing robust EWS mechanisms, countries can enhance disaster preparedness and response, generate and share valuable climate data and knowledge, and collectively build resilience to the changing climate in mountain ecosystems. Given that floods and landslides, which constitute more than half of the multi-hazard incidents and financial losses in the region, disproportionately impact women compared to men, it's imperative to enhance approaches that are sensitive to gender differences when addressing these challenges.

NbS and nature-based approaches across sectors are becoming recognised as pathways to the long-term sustainability of mountain ecosystems. Examples include ecological farming, sustainable tourism, NbS for water security, ecosystem-based adaptation (EbA)[29], livelihoods and disaster risk reduction and the use of renewable energy. All these approaches require multi-level cooperation ranging from community participation in planning to regional cooperation for knowledge sharing and replication.

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[28] Hodson, A.J., 2014. Understanding the dynamics of black carbon and associated contaminants in glacial systems. WiRes. Water, 1(2), 141–149, doi:10.1002/wat2.1016

[29] UNEP. 2015. Making the Case for Ecosystem-Based Adaptation: The Global Mountain EbA Programme in Nepal, Peru and Uganda. New York.

II. Overview of the Five Enablers and Their Interlinkages

1. Policy and Governance

Robust policy frameworks and governance systems are crucial for accelerating climate change adaptation. There is a need for coordination among policies and governance institutions (incl. among ministries and different governance levels) to effectively address the cross-cutting nature and interconnected dimensions of NbS, ecosystem resilience and climate change. Moreover, there is a challenge in considering transboundary implications and implementations of policies, particularly for ecosystems that transcend national boundaries. These policies must be precise enough to direct the necessary legal reforms, which should be based on a holistic assessment of existing gaps and potential synergies within thematic regulatory frameworks [30]. In addition, strengthening the science-policy interface will be essential for developing more effective policies.

The policy and governance frameworks surrounding NbS and EbA must include measures ensuring the participation of indigenous or ethnic groups, local communities, youth, women, and other vulnerable and marginalised groups, helping them improve their influencing abilities in this area and recognising their crucial role in the stewardship, restoration and sustainable management of ecosystems. Currently, women's participation in governance processes in the region is limited, with only 20% of parliament seats held by women in 2020, and only 7% of environment-related ministries (including ministries of agriculture, climate change, energy, fisheries, marine resources) were headed by women in 2015 [31]. There is also limited participation and engagement of local and indigenous communities in environmental and climate policy and governance. This is despite the fact that these communities often have the most profound understanding of how to safeguard the environment through traditional knowledge, sustainable management practices and customary laws.

2. Planning and Programming

Addressing the complex and long-term implications of climate change requires appropriate planning and programming. However, many nations prioritize short-term developmental objectives over long-term resilience-building efforts. There is an increasing need to strengthen both the Nationally Determined Contributions (NDCs) and the National Adaptation Plans (NAPs) that help countries integrate climate adaptation into national decision-making and long-term planning processes to reduce vulnerability associated with climate change. Currently, 11 countries in the region have NAPs in place.

Integrating ecosystems and their services into both NDCs and NAPs offers multiple benefits, including improving people's health, protecting biodiversity, and enhancing livelihoods to

[30] Iza, A. (ed) 2021. Governance for ecosystem-based adaptation. IUCN Environmental Policy and Law Paper, No. 89. Bonn, Germany: IUCN.
https://portals.iucn.org/library/sites/library/files/documents/EPLP-089-En.pdf

[31] UN Women. 2021. Snapshot of Women's Leadership in Asia and the Pacific.
https://asiapacific.unwomen.org/en/news-and-events/in-focus/csw/snapshot-of-womens-leadership-in-asia-and-the-pacific#_ftn10

enhance climate resilience[32]. In addition, given the cross-cutting nature of NbS, they can help strengthen synergistic strategies in policy-making and planning. Many Asia-Pacific countries have integrated EbA measures into their NAPs to address ecosystem threats. For instance, Fiji's NAP outlines a conceptual framework of EbA, and Nepal's NAP process is specifically looking to integrate EbA. Similarly, Bangladesh's NAP promotes NbS for biodiversity conservation, and Sri Lanka's NAP has a focus on building resilience of natural systems. Additionally, member states of the Global Commission on Adaptation (GCA) have made commitments to promote the application of NbS at a large scale by 2030, supported by specific action plans. Further, the recently adopted Montreal-Kunming Global Biodiversity Framework sets forth four main goals to be achieved by 2025, aimed at ensuring ecosystem and species health. It establishes twenty-three targets to be achieved by 2030, such as conserving 30% of land and sea, restoring 30% of degraded ecosystems, reducing the introduction of invasive species, and cutting harmful subsidies by $500 billion per year.

UNEP, in collaboration with the FAO, is leading the UN Decade on Ecosystem Restoration. This initiative is a rallying call for the protection and revival of ecosystems worldwide, aiming to benefit people and nature by building a strong, broad-based global movement to ramp up restoration efforts and set the trajectory towards a sustainable future. While the primary emphasis is on restoration, the UN Decade introduces various challenges, including one centered on climate. This challenge advocates for solutions that address both climate adaptation and mitigation. In the Asia-Pacific region, the Asian Forest Cooperation Organization (AFoCO) will co-lead this challenge, drawing upon its expertise in restoration, its extensive networks, and ongoing projects in member states.

Planning across boundaries and in partnership with neighboring countries is also important in ecosystem resilience. UNEP through the Regional Seas Programme is supporting the implementation of the Kunming-Montreal Global Biodiversity Framework with a focus on the coastal and marine environment, with particular attention to expanding marine protected areas and other effective area-based marine conservation measures which can be done at the regional level. The recent adoption of COBSEA's Marine and Coastal Ecosystems Framework provides a tangible approach towards blue economy through marine and coastal spatial planning, marine protected areas and conserving and restoring critical marine habitats, with the active participation of the nine COBSEA participating countries. Further, Adaptation Without Borders, a global partnership working to strengthen systemic resilience to cross-border impacts, identifies and assesses transboundary climate risks and appraises the options to better manage those risks, and supports policymakers, planners and the private sector to develop climate-resilient, inclusive solutions.

3. Science and Assessment

Informed decision-making regarding climate change adaptation needs to be based on robust scientific evidence and data. Globally, the IPCC WGII's contribution to the 6th Assessment Report looks at climate impacts on specific ecosystems and communities. It provides extensive data on adaptation trends, impacts and vulnerability across various sectors and

[32] UNEP. 2021. Guidelines for Integrating Ecosystem-based Adaptation into National Adaptation Plans: Supplement to the UNFCCC NAP Technical Guidelines. Nairobi.

regions[33]. Within the region, various tools and knowledge products have been developed to understand and measure the vulnerability of ecosystems and societies to climate change threats. In addition, integrating indigenous and traditional knowledge into contemporary science is a crucial step towards a more holistic and inclusive approach to understanding and addressing climate change impacts.

Yet, there exists a pressing need to build robust baseline climate data and improve the availability, access and utilisation of localized climate datasets. While countries in Asia-Pacific are strengthening their disaster preparedness, many are still lacking adequate early warning systems. The "Early Warnings for All", a UN-led initiative, aims to fill this gap and ensure that everyone on the planet will be protected by early warnings by 2027.

Further, there is a need to increase awareness and knowledge of the links between nature and climate change, and the benefits that healthy ecosystems and their services can deliver, for example, by providing the first line of defense against climate risks such as flooding. The slow uptake and scale-up of NbS can be attributed partly to this limited awareness and a long gestation period of NbS benefits for climate resilience. There is also a need to promote cross-sectoral and transboundary collaboration on climate change adaptation and to generate more compelling evidence of transboundary implementation of these solutions. For example, COBSEA's proposed work on climate resilience focuses on transboundary collaboration across six Large Marine Ecosystems and enhancing coastal resilience in the coastal megacities.

Collaboration is also key to harnessing already existing knowledge that remains under-utilised. The Lima Adaptation Knowledge Initiative (LAKI), employing a collaborative multi-stakeholder strategy, seeks to identify and close adaptation knowledge gaps, many of which are directly linked to ecosystems and ecosystem services. For instance, the lack of actionable knowledge on the impacts of climate change on ecosystems and biodiversity was identified as a primary gap during phase I of LAKI in the HKH sub-region. Further, the World Adaptation Science Programme (WASP), a UN-led think tank and knowledge hub involving over 30 core specialists from around the globe, is dedicated to addressing knowledge gaps, catering to the knowledge needs in vulnerable developing countries and providing policy-relevant science for decision-makers.

There are also several regional and sub-regional centers, including APAN, Asia-Pacific Climate Change Adaptation Information Platform (AP-PLAT), International Centre for Integrated Mountain Development (ICIMOD), the Mekong River Commission (MRC), Regional Resource Centre for Asia and Pacific at the Asian Institute of Technology (AIT RRC.AP), and SPREP, that are pivotal in facilitating research, knowledge dissemination, and policy formulation to promote ecosystem resilience in the context of climate adaptation. Their contributions are instrumental in enabling informed decision-making and the implementation of efficacious climate resilience strategies within the region.

[33] IPCC. 2022. Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi:10.1017/9781009325844 https://www.ipcc.ch/report/ar6/wg2/

4. Technologies and Practices

Technologies and practices are crucial for the effective implementation of adaptation actions and building ecosystem resilience. When developing and implementing climate-resilient and adaptive technologies and practices, it is essential to understand local context and needs. This understanding enables greater power and resources for locally-led adaptation and strengthens communities' and local stakeholders' leadership of adaptation measures that address their specific climate challenges, priorities and needs. This approach[34] acknowledges the importance of local knowledge, capabilities and ownership in building resilience to climate change.

Various applications, tools and technologies, like early warning systems, geographic information systems (GIS), remote sensing, and hydrological modeling provide invaluable data for decision-making and adaptation planning. The potential of Artificial Intelligence (AI) and big data also have a major role to play in building climate change resilience[35]. These 'hard' technologies or infrastructure can also be combined with NbS in so-called hybrid solutions to enhance advantages and overcome limitations from using standalone approaches[36]. An example of such an approach is the hybrid coastal protection system, pioneered in Fiji, which combines natural solutions, such as mangroves and vetiver plants with boulders to protect the coastline and communities from storm surges. Another example is adopting NbS to build resilience of ocean cities, a case from Samoa where the government adopted a programmatic approach to address the issue of climate change induced flooding in a river catchment. The intervention employs integrated planning and capacity building combined with flood mitigation measures through upgraded infrastructure and ecosystem solutions.[37]

As with technological advancements, effective adaptation practices must consider the practices specific to a particular ecosystem as well as the local climatic and non-climatic drivers and socio-ecological factors. For example, a UNEP project in Nepal is restoring forests and rangelands by using indigenous tree and grass species that are climate-resilient, benefiting indigenous and local communities. IUCN has also recently developed the Climate Change Resilience and Adaptation Planning Tool (CC-RAPT)[38] for practitioners and staff of marine protected areas to help them consider in depth how climate change relates to marine protected area management and the importance of intentionally strengthening management practices in the face of the climate crisis. In the context of the water sector, a guidebook for the design and implementation of EbA in Thailand's river basins was also launched[39]. In urban areas, NbS are being tailored for the local contexts to provide cooling and shade, and to reduce the urban heat island effect[40]. However, to successfully integrate NbS into national policies

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[34] https://www.wri.org/initiatives/locally-led-adaptation/principles-locally-led-adaptation

[35] Jones, A. et al. 2023. AI for climate impacts: applications in flood risk. *npj Clim Atmos Sci* 6, 63. https://doi.org/10.1038/s41612-023-00388-1

[36] UNEP-WCMC. 2019. Selecting complementary adaptation measures. EbA Briefing Note 4.

[37] https://www.undp.org/publications/nature-based-solutions-finance-ndcs

[38] https://www.iucn.org/resources/conservation-tool/climate-change-resilience-and-adaptation-planning-tool

[39] https://www.iucn.org/story/202302/new-guidebook-promotes-ecosystem-based-adaptation-within-thailands-water-sector

[40] UNEP. 2021. Beating the Heat: A Sustainable Cooling Handbook for Cities. Nairobi.

and strategies and implement these in other country contexts, successful solutions and technologies need to be scalable. While urban NbS approaches and hybrid solutions are slowly gaining momentum, there is a need for wider application, particularly in Asian megacities.

In addition, the Climate Technology Centre and Network (CTCN), the implementation arm of the Technology Mechanism of the UNFCCC hosted by UNEP, promotes accelerated, diversified and scaled-up transfer of environmentally sound technologies for climate change mitigation and adaptation in developing countries, in line with their sustainable development priorities. Through its recently opened Partnership and Liaison Office based in the Republic of Korea, the CTCN aims to open new avenues of collaboration on technology development and transfer support to combat climate change and build resilient societies.

5. Finance and Investment

The global adaptation costs have been estimated to be $160-340 billion by 2030 and $315-565 billion by 2050, and in the region, financing needs for the 2021-2030 period were estimated to be $27-208 billion per year[41]. To effectively implement adaptation activities and strengthen climate change resilience, there is an urgent need to scale up adaptation finance and investments. In addition, investments for NbS and ecosystems stood at $154 in 2022 which is significantly lower than the required $384 billion per year by 2025 and $484 billion annually by 2030 to ensure we remain under a 1.5°C temperature rise and avert biodiversity loss[42]. Climate change funding is typically donor-driven and only a fraction of it benefits local communities. There is also a need to strengthen mechanisms that enable improved access to existing climate funds particularly for local communities, and women and marginalised groups. Both domestic public financing for adaptation and ecosystem resilience and private sector engagement and investment in these areas are currently limited.

Nevertheless, numerous innovative approaches to catalyse nature and climate finance have emerged. Major funds and programmes promote the links of nature and climate, such as the ADB the Regional Flyway Initiative[43], a program that aims to preserve priority wetlands across the region. As of early 2023, 45% of the Green Climate Fund's portfolio contributed to NbS[44]. Further, the recently launched Global Biodiversity Framework Fund to finance the implementation of the Kunming-Montreal Global Biodiversity Framework (which sets a goal to have at least 30% of the planet under protection by 2030) will help boost countries' ability to protect, restore, and ensure the sustainable use of nature.

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[41] UNEP. 2022. Adaptation Gap Report 2022: Too Little, Too Slow – Climate adaptation failure puts world at risk. Nairobi. https://www.unep.org/adaptation-gap-report-2022

[42] UNEP. 2022. State of Finance for Nature. Time to act: Doubling investment by 2025 and eliminating nature-negative finance flows. Nairobi. https:// wedocs.unep.org/20.500.11822/41333

[43] https://www.adb.org/news/adb-launches-regional-flyway-initiative-preserve-priority-wetlands

[44] GCF. 2023. Green Climate Fund Working Paper No.5 Making blended finance work for nature-based solutions.

Implemented by IUCN and UNEP, the Global EbA Fund[45] is a funding mechanism for catalytic, innovative, and inclusive projects that aim to create an enabling environment for the implementation of EbA to enhance the resilience of vulnerable communities and ecosystems to the impacts of climate change. With the focus on EbA, the Fund is strategically positioned to connect and contribute to the delivery of global agendas on the climate change–biodiversity nexus, including in the Asia-Pacific region. For example, a project in Vietnam is strengthening livelihoods by improving market and finance access and building links to finance opportunities, such as Payments for Ecosystem Services schemes. Further, a project in Indonesia[46] is supporting the building of climate-resilient livelihoods and aims to develop a blueprint for blue carbon financed mangrove restoration combined with sustainable aquaculture. Another exemplary fund, the Blue Carbon Accelerator Fund[47], hinges on the Blue Natural Capital concept, underscoring the potential of coastal and marine ecosystem conservation and restoration through revenue streams derived from their multiple ecosystem services[48]. By documenting successful case studies and enhancing capacity, this project also seeks to provide evidence for the potential of private sector investments in EbA as a vital component of climate adaptation strategies.

[45] The Global EbA Fund is financed by the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV). https://globalebafund.org/

[46] https://globalebafund.org/304_1_176/

[47] https://www.iucn.org/news/marine-and-polar/202111/new-blue-carbon-accelerator-fund-support-blue-carbon-entrepreneurs-and-leverage-private-sector-finance

[48] https://bluenaturalcapital.org/

III. Opportunities to support and catalyse transformative actions

1. Making ecosystems and ecosystem services' contributions more visible

While it is estimated that over half of the world's gross domestic product (GDP) relies on ecosystem services, only a small portion of these services are captured in economic terms and therefore the economy's reliance on nature and its subsequent impacts, such as water quality degradation and deforestation, are largely invisible. This includes the resilience benefits that ecosystems provide to communities. Natural capital accounting approaches, such as the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA), aim to make these services visible by valuing and quantifying natural resources and ecosystems in economic terms. The underlying premise is that 16ecognizing nature as a valuable asset that needs to be measured, maintained, and managed will enable informed decision-making, promote sustainable development, and encourage conservation efforts to protect biodiversity and the environment.

2. Transitioning from a sectoral approach to a systems approach

Climate change impacts and ecosystems are not confined to specific sectors or national boundaries. With cascading and transboundary risks taking place across all sectors and regions, including in transboundary ecosystems (both terrestrial and marine), coordinated and collective action to strengthen adaptation at local, regional and international levels is critical to building resilience. Effective and transformative adaptation therefore requires moving from a sectoral approach to an integrated systems approach that promotes coherence and co-development of policies, strategies, and knowledge through partnerships and collaboration – including across borders. Horizontal and vertical integration can help identify synergies and interactions that further promote effective resilience building and planning, and integrate perspectives, such as traditional and indigenous knowledge and practices, that have traditionally been overlooked in policy formulation and resilience building efforts.

3. Fostering locally-led approaches to adaptation

Local communities are on the frontlines of climate change impacts, and indigenous peoples, who manage or have tenure over 25% of the world's land surface, are essential in designing and implementing solutions for ecosystems. Yet, these communities do not hold the decision-making power nor the resources to effectively implement adaptation actions or strengthen ecosystem resilience. Fostering locally-led approaches, such as through the locally-led adaptation principles, can ensure equitable access to decision-making and financing. This approach aims to redress historical imbalances of power and resources while simultaneously recognising the value of local and traditional knowledge and expertise in countering climate challenges.

4. Strengthening financing

The most pressing financing need in the region is to develop sustainable and long-term financing mechanisms to ensure the longevity of NbS implementation. There is also an urgent need to realign, repurpose or reorient existing finance flows to strengthen investments for nature and climate because currently, nature-negative solutions have been shown to outpace

investments into NbS or nature-positive solutions by 3-7 times[49]. Given that NbS receives only a small part of overall climate change financing, it remains underfunded. Innovative financing mechanisms and investments from different sources (including blended finance solutions that integrate different financing approaches and mechanisms based on their pros and cons) are needed to strengthen and diversify the finance base for NbS and help catalyse wider implementation. Many major donors in the region, such as the Green Climate Fund, are aiming to de-risk investment to mobilise finance at scale and catalyse climate innovation. Still, commitment and participation from the private sector will be essential to the long-term continuity of NbS implementation in the region. These investments are needed for long-term research for data management and exchange, and to support better monitoring and evaluation to track the effectiveness of strategies.

[49] UNEP. 2022. State of Finance for Nature. Time to act: Doubling investment by 2025 and eliminating nature-negative finance flows. Nairobi. https://wedocs.unep.org/20.500.11822/41333

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