Synergies between adaptation, biodiversity and mitigation

How Ecosystem-based Adaptation can build bridges between Nationally Determined Contributions and the new Global Biodiversity Framework

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List of Abbreviations

CBD	Convention on Biological Diversity
ACEEE	American Council for an Energy-Efficient Economy
AFOLU	Agriculture, Forestry and Other Land Use
CBD	Convention on Biological Diversity
CBO	Community-based organisation
COP	Conference of the Parties
EbA	Ecosystem-based Adaptation
FAO	Food and Agriculture Organization of the United Nations
IISD	International Institute for Sustainable Development
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated water resources management
GBF	Global Biodiversity Framework
GCF	Green Climate Fund
GDP	Gross domestic product
GHG	Greenhouse gas
NAP	National Adaptation Plan
NbS	Nature-based Solution
NBSAP	National Biodiversity Strategy and Action Plan
NDC	Nationally Determined Contribution
OAA	Other aquatic animal
OECD	Organisation for Economic Co-operation and Development
SDG	Sustainable Development Goals
UNEA	United Nations Environment Assembly
WWF	World Wide Fund For Nature

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1. Why take another look at synergies – and why now?

Our planet faces **multiple crises.** The Covid-19 pandemic and armed conflicts are increasing instability, food insecurity and poverty in countries around the world. Climate change and biodiversity loss will bring yet-unknown social, ecological and financial impacts. Worldwide **degradation of ecosystems** already undermines the well-being of at least 3.2 billion people and results in the **loss of ecosystem services valued at about 10% of annual global GDP**[1]. Further reductions in biodiversity and ecosystem integrity will slow or reverse progress on many fronts – from food security to economic development – and will also hinder climate change adaptation and mitigation.

Healthy and resilient ecosystems are vital for reducing our vulnerability to climate change impacts; they are also important carbon sinks [2] and at the same time enhance people's quality of life. Ecosystem-based approaches thus offer multiple benefits for **adaptation, mitigation, biodiversity conservation, and human well-being.** The restoration of wetlands, for example, can enhance water storage capacity, reduce flooding risks and serve as a carbon sink, whilst also providing habitats for migratory birds and aquatic or terrestrial animals as well as an additional source of income through fisheries and other aquatic animals (OAAs).

Science clearly recognises the key role that ecosystems play. The International Panel on Climate Change (IPCC) and Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) have both highlighted the **interdependency between climate and biodiversity** in their scientific assessments as well as in a joint workshop report on biodiversity and climate change[3]. IPCC's Sixth Assessment Report (AR6) also highlighted the potential of Ecosystem-based Adaptation for achieving climate-resilient development (CRD).

According to the IPCC (see Box 1), even though EbA offers solutions that deliver multiple benefits, such approaches have not yet been widely implemented. Much remains to be done toward **mainstreaming ecosystem-based solutions**. Particularly urgent is the need to boost awareness that ecosystem-based approaches can create synergies between the climate and biodiversity agendas, permitting gains in one to reinforce advances in the other[4].

Box 1: The IPCC on Ecosystem-based Adaptation

According to the latest IPCCC report on impacts, adaptation and vulnerability, 'Ecosystem-based Adaptation (EbA) can deliver climate change adaptation opportunities for people, while also providing multiple additional benefits, including for biodiversity (high confidence). An increasing body of evidence demonstrates that climatic risks to people, including from flood, drought, fire and overheating, can be lowered by a range of Ecosystem-based Adaptation techniques in urban and rural areas (medium confidence). EbA forms part of a wider range of Nature-based Solution (NbS) actions and some have mitigation co-benefits, including the protection and restoration of forests and other high-carbon ecosystems, as well as agroecological farming practices. However, EbA and other NbS are still not widely implemented.

To realize potential benefits and avoid harm, it is essential that EbA is deployed in the right places and with the right approaches for the specific area, with inclusive governance (high confidence). Interdisciplinary scientific information and practical expertise, including local and Indigenous knowledge, are essential to effectiveness (high confidence). There is a large risk of maladaptation where this does not happen'. (Source: IPCC (2022): 6th Assessment Report on Impacts, Adaptation and Vulnerability.)

There is growing international recognition of this important role of ecosystems. One example is the establishment of Ad Hoc Technical Expert Groups on Biological Diversity and Climate Change under the CBD[5]; another is the UN Decade for Ecosystem Restoration[6].

In this paper, looking at the national level, we argue that the update of Nationally Determined Contributions (NDCs) – which often include new and ambitious efforts to adopt ecosystem-based approaches, also referred to as nature-based solutions (NbS) – offers a **window of opportunity** to foster climate-biodiversity synergies.

Box 2: Definition of Nature-based Solutions

In March 2022, the United Nations Environment Assembly (UNEA-5) adopted a multilaterally agreed definition of NbS, recognising their important global role in responding to climate change and its social, economic and environmental impacts. The resolution defines NbS as an umbrella term, including all: 'actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits'. The 'Resolution on Nature-based Solutions for Supporting Sustainable Development' also calls on the United Nations Environment Programme (UNEP) to support the implementation of NbS that safeguard the rights of communities and indigenous peoples[7].

NbS should, by definition, provide biodiversity benefits (see Box 2) and therefore contribute to international and national biodiversity targets, as outlined in National Biodiversity Strategies and Action Plans (NBSAPs). The 15th meeting of the Conference of the Parties (COP15) of the UN Convention on Biological Diversity, held in Kunming and Montreal, in December 2022 adopted a new **Kunming Global Biodiversity Framework** (GBF). **NBSAPs will require updating to align** them with these new international targets. To this end, countries should make sure to **include and build on the ecosystem-based approaches** to which they have already committed in their national climate strategies and action plans, especially NDCs and National Adaptation Plans (NAPs). By creating synergies between national climate change and biodiversity targets as well as integrating these targets into budgetary and other processes, countries can help ensure that the targets are consistent, better harmonise donor funding and encourage greater private sector involvement[8]. In short, building synergies between climate and biodiversity policies can increase the possibility of international support for implementing and upscaling such measures and policies.

To demonstrate **how synergies could look concretely** in specific cases – including less obvious impacts – this paper presents examples from three key sectors – water, agriculture and cities – all taken from updated NDCs. The three cases are the following:

1. 'Recharge Pakistan' aims for large-scale wetland ecosystems to reduce flood risk and recharge groundwater aquifers.
2. Jordan plans to extend green spaces for greater urban resilience in Amman.
3. Costa Rica aims to increase the agricultural area under silvopastoral systems[9].

Several other NDCs provide examples of similar NbS in these and many other sectors, though often describing them in less detail. The cases selected for this paper include ambitious and mostly quite specific measures; other documents describe some of these measures in further detail[10]. A key question for the analysis of synergies with biodiversity is how these NDC commitments would probably contribute to the new Global Biodiversity Framework (GBF). Nature-based solutions in NDC do not only contribute to GBF target 8 on climate change, but in most cases also to several other GBF targets, e.g. on ecosystem restoration, benefits for air quality, etc. (see Box 3).

To ensure that greater alignment and coherence translate into effectiveness on the ground, ecosystem-based approaches must not only consider socio-economic aspects but **actually advance the social justice agenda**. Specifically, all measures planned and executed must take fully into account the diverse needs and vulnerabilities as well as the rights and knowledge of all members of society. For this purpose, we included a perspective on 'society' in this paper, in the sense of looking at all relations to human society besides those directly targeted by adaptation, and we highlight issues around **climate justice**.

Interlinkages between mitigation, adaptation, biodiversity and human well-being do not necessarily lead to positive outcomes. In fact, **maladaptation**[11] and ecosystem damage may result if potential impact pathways are not adequately considered. Beyond analysing water, agriculture and cities, this paper thus offers a more general but **systemic view** that considers negative impact pathways.

Part 2 of this paper highlights key considerations on the role of EbA in building bridges that bring multiple benefits for adaptation, mitigation, biodiversity, society and human well-being. **Part 3** applies this perspective to the three cases outlined above. **Part 4** then explores some potential positive and negative impact pathways in these sectors, with a focus on 'society' and a social justice perspective. Finally, **Part 5** presents the authors' recommendations on how to move forward.

2. What to consider on synergies and EbA?

Once we gain a better understanding of **why** the synergies between adaptation, mitigation, biodiversity and society are important (and why now), we must then consider **how** best to examine them: What is the potential of EbA in this regard? What risks may arise? What role do justice and equity issues play?

Often, **synergies** are labelled as co-benefits, for example, adaptation or biodiversity **co-benefits** that result from mitigation projects and vice versa. Whilst thus delivering multiple benefits, such projects do not necessarily involve any **interaction** between these benefits. For example, a mitigation project that promotes the use of efficient wood stoves might reduce illegal logging and fuel wood collection, thus reducing deforestation and creating a biodiversity co-benefit. Even so, the project may not necessarily involve any interaction between climate and biodiversity conservation.

In our view, to identify synergies between climate and biodiversity requires seeking **conscious interactions and planned interlinkages at a functional level**. For example, restoring, protecting or managing ecosystems for biodiversity conservation will usually also enhance the mitigation impact of the services that these ecosystems provide (by protecting carbon sinks or promoting carbon sequestration). These services can also have adaptation impacts (e.g., by protecting against drought or floods)[12].

Much depends on the project focus, as the synergies between climate and biodiversity are **not the same for mitigation as for adaptation**. For example, a project using ecosystem-based approaches to improve soil health[13] might focus on soil organic carbon to achieve mitigation, whilst to enhance adaptation, it might focus more on the regulatory function of soils in the water cycle. Increasing soil organic carbon for mitigation might have different impacts on soil biodiversity than the restoration of degraded soils for adaptation to drought impacts. Thus, rather than search broadly for 'climate-biodiversity' linkages, one must examine such interlinkages between mitigation and adaptation separately and in detail. Many countries already recognise such linkages and highlight them in national policy documents[14], including their updated NDCs. Now that a new Global Biodiversity Framework has been adopted, countries should also consider the interlinkages between their NDCs and the new international biodiversity targets – beyond the 'climate targets'.

The search for climate-biodiversity synergies should encompass the entire social-ecological system, since natural and human systems are closely interlinked (e.g., biodiversity conservation can **impact climate justice, gender and intersectionality**). Hence the need to consider the specific context of conservation actions: A solution that works at one location may give rise to inequality at another. When implementing a project, one needs to think about the potential **positive spinoffs or negative impacts** on other actors, locations or sectors. This is one reason why the latest IPCC reports calls for 'climate-resilient development' that needs 'to consider aspects of equity and justice, and is based on healthy ecosystems and human well-being'.

For example, in pursuing an intersectoral approach to water and agriculture (two of the sectors that are most vulnerable to climate change), one must not ignore the **roles of different social groups**. Let us assume that such an initiative plans to reduce the flooding risks caused by extreme weather events. One adaptative measure is to build grey infrastructure, such as dikes and protection walls, whilst another option consists of ecosystem-based approaches, such as rehabilitation of riverbank ecosystems. The EbA approach could provide benefits for adaptation, biodiversity and mitigation, whilst also creating opportunities to strengthen the resilience of vulnerable social groups. Rehabilitating riverbank ecosystems into green areas can thus achieve adaptation and biodiversity conservation simultaneously. This measure contributes to mitigation as well, since green areas not only absorb CO_2 but avoid emissions generated by the construction of grey infrastructure, including the sourcing of construction materials. This measure has a social element as well, requiring close observation of the needs of local communities.

Box 3: The Kunming-Montreal Global Biodiversity Framework

At the CBD COP15 in Kunming and Montreal, on December 19th 2022 a new GBF was adopted that provides a strategic vision and a global roadmap for the conservation, protection, restoration and sustainable management of biodiversity and ecosystems for the next decade. The framework includes an ambitious plan of action aimed at transforming society's relationship with biodiversity and ensuring the fulfilment by 2050 of a shared vision of living in harmony with nature. The CBD's COP15 has adopted this new GBF through a comprehensive and participatory process. This paper analyses the targets of this new GBF for potential synergies with updated NDC. In order to give an overview of the 23 targets of the GBF, we have narrowed them down for this paper to the following unofficial and abbreviated list of key terms:

CATEGORY 1: REDUCING THREATS TO BIODIVERSITY[15]

Target 1. Spatial planning (addressing land- and sea-use change, and retaining intact and wilderness areas)
Target 2. Restoration of degraded ecosystems
Target 3. Conservation and management of terrestrial, inland water, coastal and marine areas
Target 4. Recovery and conservation of species (including genetic diversity)
Target 5. Sustainable harvesting, trade and use of wild species
Target 6. Control of invasive alien species
Target 7. Reduction of pollution from all sources
Target 8. Impact of climate change and ocean acidification, and resilience of biodiversity

CATEGORY 2: MEETING PEOPLE'S NEEDS THROUGH SUSTAINABLE USE AND BENEFIT-SHARING

Target 9. Generating benefits for people and livelihoods through sustainable management of wild species
Target 10. Sustainable management of areas under agriculture, aquaculture and forestry
Target 11. Regulation of air quality , water quantity and quality and protection from hazards and extreme events
Target 12. Green and blue spaces in cities and other densely populated areas
Target 13. Access to genetic resources, with fair and equitable sharing of benefits

CATEGORY 3. TOOLS AND SOLUTIONS FOR IMPLEMENTATION AND MAINSTREAMING

Target 14. Alignment and integration into policies and processes
Target 15. Assessment and reporting of all businesses on biodiversity and reduction of negative impacts
Target 16. Sustainable consumption, including access to information and alternatives
Target 17. Biotechnology's potential adverse impacts on biodiversity and human health
Target 18. Incentives and subsidies that harm biodiversity
Target 19. Increase of financial resources from all sources
Target 20. Capacity-building, technology transfer and scientific cooperation
Target 21. Access to data, information, and knowledge. Communication, Education, Monitoring
Target 22. Gender-responsive representation and participation, Justice for indigenous peoples and local communities
Target 23. Gender equality, including equal rights and access

The next section includes references to this list.

Different types of green measures will be more or less suitable, **depending on the context**. In many riparian communities of Southeast Asia's Mekong region, for example, creating areas for small-scale riverbank agriculture offers important benefits. This not only helps adapt buffer zones to flooding but also provides **livelihoods for local communities**. If riverbank agriculture is implemented well (e.g., by using intercropping techniques with native staple foods), it also has potential to foster biodiversity by increasing the variety of riverine habitats and thus the diversity of fauna and flora. In an urban context, such as Shanghai, recreational areas may be a more appropriate option that better fits society's needs[16]. The approach centred on riverbank agriculture is suitable for the Mekong region, because it enhances the resilience of more vulnerable social groups. Green spaces, in contrast, would limit their access to riverbank agriculture, which serves as an additional income source. Hence, **context is key** to success in introducing such measures.

Current practices tend to seek complementarity (i.e., mitigation projects providing adaptation and biodiversity co-benefits and vice versa) rather than consciously define synergies during the planning phase. Such is the case for many projects that rely on a landscape approach to integrate policies and practices for multiple land uses in a given area. Seeking synergies rather than complementarity in such projects is more likely to optimise adaptation and mitigation within landscapes. This requires a **paradigm shift** from the current silo mentality concerning adaptation, mitigation and biodiversity conservation to systems thinking about land- and seascapes but without losing sight of specific contexts and the needs of societies/communities.

Achieving synergies further requires policies at the global, national and local levels that foster good governance, strong institutional capacities and favourable investment conditions (see Figure 1). Or as the IPCC asserts: 'It is essential that EbA is deployed in the right places and with the right approaches for that area, with inclusive governance'. As governments seek to align climate and biodiversity policies, they need to create enabling environments via strengthened capacities, more coherent policies, enhanced governance structures and tailored financing.

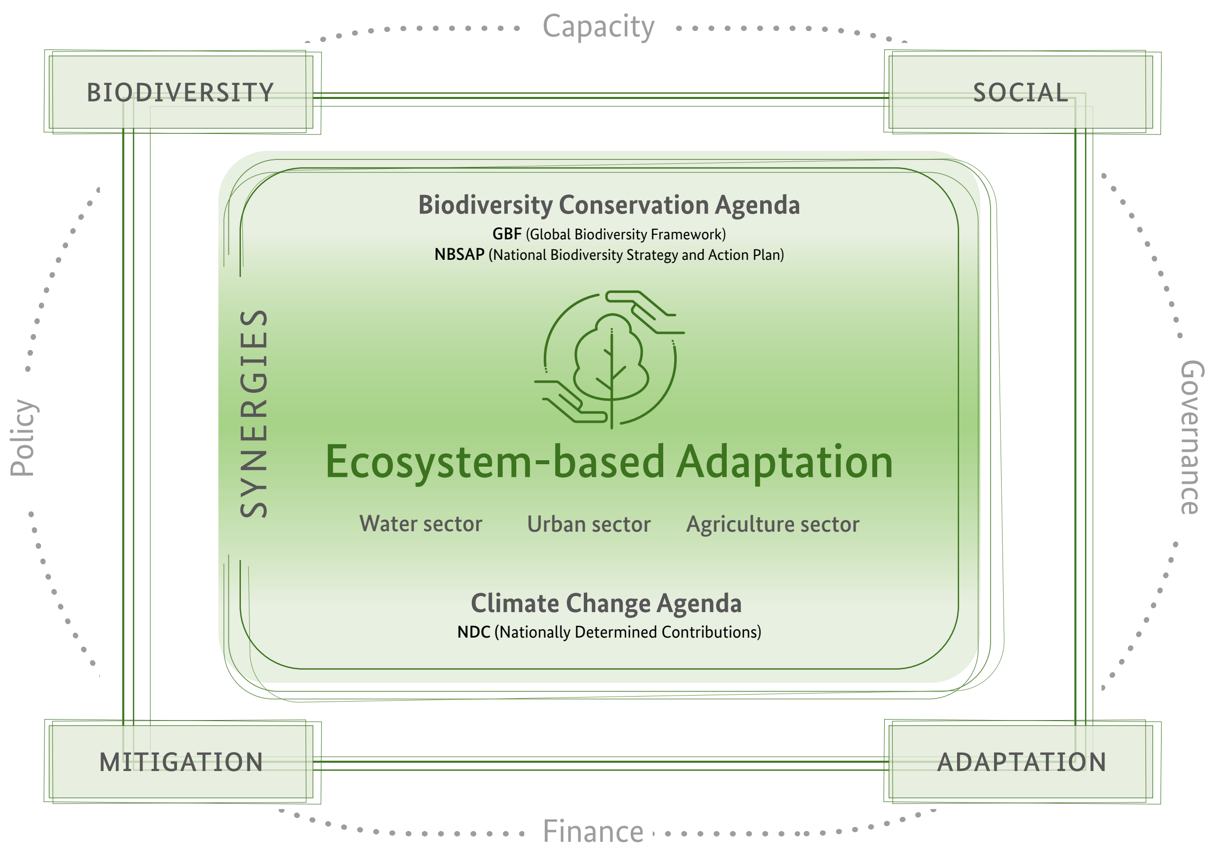


Figure 1: Synergies between biodiversity, climate adaptation and mitigation (examples). (Source: Th. Amend & L. Ilieva)

3. Exploring synergies by sector

3.1 Water

Almost every national policy on climate change or biodiversity conservation makes reference to 'water-related' issues. In NDCs, this often concerns adaptation measures aimed at curbing **climate-induced risks**, such as floods and droughts. Other key concerns include groundwater depletion and **water scarcity, water quality** and problems such as soil erosion, stagnant agricultural productivity and many more. The water sector is often well aware of the strong interlinkages between adaptation, mitigation, biodiversity and socio-economic conditions, though it has not yet fully integrated ecosystem-based approaches into policies[17]. Even so, there are positive examples: A number of NDCs[18] (including Pakistan, Ethiopia, Mexico, the European Union and Peru) feature ecosystem-based approaches aimed at protecting, managing or restoring water resources. Pakistan's updated NDC, for example, explicitly mentions 'Ecosystem-based Adaptation'. Similarly, EbA solutions relying on natural infrastructure to reduce water-related risks can be designed to deliver multiple benefits for mitigation and biodiversity (e.g., through tree planting on upper slopes and along rivers to increase carbon sequestration or through the restoration of critical habitats in **wetlands and peatlands**). These examples show how countries can create important carbon sinks, whilst also enhancing natural defences against water-related risks and contributing to biodiversity goals as part of the GBF.

CASE STUDY

Pakistan: The catalysing role of wetland restoration for reducing flood risk, whilst enhancing critical habitats and carbon capture

From June to September 2022, severe floods hit Pakistan, claiming more than 1,300 people dead and causing at least 30 billion USD worth of damage[19]. Ranked as the **eighth country most affected** by climate change impacts from 2000 to 2019[20], Pakistan is also one of the world's most water-stressed countries, with the highest water use and water intensity rates (water used per unit of GDP)[21]. In the last 10 years, extensive floods have had **substantial socio-economic impacts**. In the future, flash floods are likely to become more frequent and intense, as a result of extreme rainfall, including a projected increase in the South Asian monsoons (as occurred in August-September 2022), combined with drier and more compacted soils caused by higher temperatures and lower numbers of wet days[22]. Ecosystems that have potential to regulate floods, such as wetlands and floodplains, are degraded, disconnected and constrained by irrigation infrastructure, thus reducing their capacity for groundwater recharge and storage. This has hampered the natural ability of the Indus River Basin to absorb runoff, so that extra flows pass downstream, exacerbating flood peaks.

Pakistan's updated NDC (2021)[23] prioritises **an integrated approach to reducing flood risk** and recognises the potential of EbA measures to provide solutions. The country gives particular emphasis to degraded wetlands and is committed to restoring 10% of them by 2030. Wetland restoration and management are critical EbA solutions for building community resilience and reducing disaster risk. **Restored wetlands** can alleviate the flooding and scouring effects of extreme rainfall or rapid snowmelt (leading to the underwashing of infrastructure foundations), whilst improving habitats and better enabling species to migrate. Healthy wetlands can also provide **local communities** with many **social and economic benefits** (e.g., reeds to serve as thatching material for roofs, fish for more protein-rich diets, clean water for drinking and diverse bird habitats, which attract tourism and create jobs for locals as tour guides).

→ Water sector: Creating synergies between adaptation, mitigation, biodiversity and society

Box 4: Pakistan – Synergies in the water sector

ADAPTATION

reased community resilience, and more resilient built infrastructure, such as dams[24]

MITIGATION

Increased carbon sequestration, including 'blue carbon', and protection of ecosystems as carbon sinks

BIODIVERSITY

Provision of critical habitats for migratory and resident species, enhanced ecosystem diversity and connectivity as well as ecosystem service delivery

SOCIETY

Diversification of livelihood strategies, with positive impacts on water quality and security, thus contributing to improved quality of life and strengthening communities' resilience

Wetland restoration offers considerable gains in carbon sequestration. Wetlands, particularly peatlands and coastal systems (salt marshes, mangroves and sea grasses), store vast amounts of carbon, both in plant biomass and especially in the soil (Ramsar Convention on Wetlands, 2018). For this reason, Pakistan's NDC recognises wetland restoration as a promising option for carbon sequestration (also referred to as 'blue carbon'). If restoration of the country's coastal wetlands is included, a preliminary estimate of their total blue carbon stocks amounts to 20,835,977 tonnes organic carbon[25].

Wetland restoration protects critical habitats and enhances biodiversity. Restoring degraded ecosystems increases species abundance, enhances ecological connectivity and diversity, and improves habitat quality. Pakistan's NBSAP stresses the importance of wetland ecosystems in particular[26]. This national policy aims to protect 15% of wetland areas possessing significant biodiversity, in line with Pakistan's NDC target. Improved water availability will also create healthier habitats (e.g., riverine forests and wetlands), whilst enhancing associated ecosystem services (e.g., fish stocks, clean water and fodder sources) as well as living conditions for key species (e.g., the endangered Indus river dolphin, which is endemic to the Indus River Basin)[27].

Healthy wetlands provide natural water filtration and retention, and contribute to food security[28]. Though not specifically mentioned in Pakistan's NDC, the ecosystem services that wetlands provide can improve water quality through natural water filtration, catching sediments and pollution as water flows through them. In the surrounding communities, this can greatly reduce the public cost of water sanitation systems[29]. Wetlands also contribute to food security by securing fisheries and other aquatic animals (OAAs), whilst providing water for irrigation in small- and medium-scale agriculture as well as building materials (thatch for roofs, wood, etc.) and livestock fodder. Healthy wetland ecosystems thus hold great potential for contributing to various Sustainable Development Goals (SDGs), including 2 (zero hunger), 3 (good health and well-being) and 6 (clean water and sanitation). Pakistan's NDC specifically states that local women's unions can play a key role in protecting and managing waterbodies, including wetlands. This also increases capacity, and brings the knowledge of indigenous people and local women into the development of alternative technologies for irrigation and water management, thus contributing to SDG 5 (gender equality).

Potential synergies with the GBF: Wetland restoration, as outlined in the NDC and further detailed in a Green Climate Fund (GCF) concept note, should target on climate change and ocean acidification (target 8) in the new GBF. This should at the same time contribute to targets under Category 1, that is, reducing threats to biodiversity through the restoration of degraded ecosystems (target 2), and improving the conservation and management of ecosystems (target 3). In addition, this measure should contribute to targets concerned with meeting people's needs, for example, by improving the regulation of water quality and quantity, and by protecting communities from hazards and extreme events (target 11). Wetland restoration should also facilitate mainstreaming, especially by helping mobilise financial resources (e.g., from the GCF – target 19). These are strong arguments for including and further developing this NDC measure in an updated NBSAP.

3.2 Agriculture

The agriculture sector is well aware of the interlinkages between climate, biodiversity and human well-being, recognising in particular the importance of water availability and healthy soils for agricultural productivity. Land use change and agriculture are amongst the biggest drivers of biodiversity loss, resulting from the destruction and conversion of natural habitats to intensely managed crop production or grazing. This also reduces soil health and damages other ecosystems indirectly through the use of pesticides and fertilisers as well as sedimentation of eroded soils. Emissions from AFOLU (agriculture, forestry and other land use) accounted for about a quarter of net anthropogenic emissions (including deforestation, emissions from soil and nutrient management, and livestock).

Global agriculture today faces a number of challenges, including **rising demand for agricultural commodities** together with deterioration of the natural resources needed to produce food. These pressures can only increase as the world population grows to an estimated 9 billion people by 2050. Climate change will impact agriculture directly and negatively, affecting most regions and crops. These impacts include higher mean temperatures, greater variability in temperature and rainfall patterns, changes in water availability, increased frequency and intensity of extreme weather events, and changes in ecosystems. As a result, the average yields of most crops are likely to decline in practically all regions, thus exacerbating **hunger and poverty**. For example, in OECD countries, the yields of maize, wheat and rice are projected to decline, on average, by 10%, 7% and 6%, respectively, by 2050[30]. Agriculture must therefore adapt to climate change, whilst also helping mitigate its impacts through forest conservation and management, amongst other strategies.

We focus here on silvopastoral systems, as they are included in several updated NDCs (e.g., Burundi, Zimbabwe, Dominican Republic and Costa Rica) but with little analysis of the related synergies between adaptation, mitigation, biodiversity and society. In a silvopastoral system, grassland pastures – often degraded – are gradually converted to diverse pastures mixed with trees to offer ecosystem services, such as shading and fodder for livestock, timber, etc. Often reflecting traditional land use and knowledge of resource use, this system can improve overall adaptive capacity together with social and ecological resilience, whilst also enhancing carbon stocks above and belowground as well as favouring biodiversity. Silvopastoral systems have proved successful in many tropical regions for livestock farming.

CASE STUDY

Costa Rica: Silvopastoral systems transform landscapes to ensure climate-resilient, low-carbon and biodiversity-rich agricultural development

Costa Rica's revised NDC expresses strong commitment to developing **highly efficient, resilient agri-food systems** that generate low-carbon goods for export and local consumption, and also to promoting a model for livestock production that stresses efficiency and greenhouse gas reduction. The country aims to increase the area of silvopastoral and agroforestry systems by 69,500 hectares toward 2030. Included in the NDC chapter on 'forests and terrestrial biodiversity', this measure explicitly seeks synergies with biodiversity.

Silvopastoral systems often involve practices such as crop rotation (fallows), mixed cropping, water harvesting, incorporation of multi-purpose shrubs and trees, haymaking, and selective cutting. They respond to the increasing vulnerability of agricultural production to more frequent extreme climatic events, rising average temperatures and changing rainfall patterns, contributing importantly to **climate adaptation**. These systems illustrate especially well how an ecosystem-based approach can help control soil erosion caused by water, avoid declining soil fertility, improve crop production and alleviate poverty. They also improve water retention and groundwater recharge, create a microclimate suitable for animals and people, boost livestock productivity, and help diversify agriculture and forestry systems.

→ Agriculture: Creating synergies between adaptation, mitigation, biodiversity and society

When used as EbA solutions to enhance the climate resilience of cattle production, silvopastoral systems can also potentially contribute to mitigation and biodiversity conservation, whilst also improving the well-being of people and animals.

Box 5: Costa Rica – Synergies in the agriculture sector

ADAPTATION
Better microclimate and water retention as well as reduced soil erosion and land degradation

MITIGATION
Enhanced carbon stocks in soils and avoided greenhouse gas (GHG) emissions

BIODIVERSITY
Increased biological diversity in soils and the creation of habitats with native trees and shrubs

SOCIETY
Increased productivity, reduced production costs, diversification of income, enhanced animal welfare and easier access to finance.

Key mitigation benefits from silvopastoral systems include enhanced carbon stocks in soils. The mitigation benefits of these systems are generally divided into three broad categories:

1. Increased carbon stocks above and belowground
2. Lower direct agricultural emissions (of carbon dioxide, methane and nitrous oxides) throughout agricultural production
3. Reduced deforestation and degradation of high-carbon ecosystems in new agricultural areas

In the seasonally dry lowlands of Costa Rica, native species of nitrogen-fixing trees (Pithecellobium saman, Diphysa robinioides and Dalbergia retusa) were grown in association with fast-growing pastures (Brachiaria brizantha), which were grazed for 4 or 5 days with intervals of 1–2 months between grazing. In the silvopastoral systems, total carbon in above and belowground phytomass amounted to 12.5 Mg C/ha, compared to 3.5 Mg C/ha for treeless control pastures dominated by Hyparrhenia rufa[31].

Silvopastoral systems promote sustainable use of biodiversity, thus enhancing habitats and ecosystem connectivity. When these systems are designed and managed well, native tree species, such as Diphysa robinioides and Dalbergia retusa, can foster biodiversity in various ways. For example, they can enhance connectivity through shrubs and hedges (providing ecological micro-corridors), increase soil biological activity and resources (organic matter and nutrients), create more diverse habitats, and add to the ecology's overall functionality and resilience.

Integrating livestock and forestry systems has much potential for offering significant benefits to society through improved animal welfare, higher productivity and revenue as well as better access to finance. Though not mentioned explicitly in the NDC, well-managed silvopastoral systems generate more income by diversifying revenue streams (from wood production and livestock[32]) as well as by enhancing the quality of meat and dairy production[33]. In addition, improved animal welfare reduces disease incidence and stress for cattle, potentially lowering production costs through smaller veterinary bills and numbers of cattle deaths. With more diverse income sources, producers can more readily access finance. Those relying solely on forestry are hard pressed to obtain loans, as returns are commonly delayed until at least the fifth to seventh year. Since cattle production generates yearly revenue, increased cash flow can make farmers more eligible for small loans and grants. Together, these gains contribute to SDGs 1 (no poverty), 2 (zero hunger), 3 (health and well-being) and 12 (responsible consumption and production).

Potential synergies with the GBF: In addition to the mitigation and adaptation target in the GBF (target 8), silvopastoral systems should also contribute to the recovery of degraded ecosystems (target 2) and most likely improve degraded pastures, whilst also increasing ecosystem connectivity (also target 2). These systems should contribute to sustainable management of areas under agriculture, aquaculture and forestry (target 10), and possibly also increase use of the traditional knowledge of indigenous peoples and local communities regarding the value of trees and shrubs for fodder, medicine etc. (target 20).

3.3 Cities

Designing and planning urban and rural settlements together with their infrastructure in ways that address climate change impacts and risks is critical for enhancing resilience and human well-being[34]. Urban sprawl typically comes at the expense of open spaces, which are covered with artificial surfaces, consisting of concrete, asphalt and other impervious materials. This inevitably increases the risk of a **heat island effect**, due to trapped heat, and of **floods** resulting from rainwater runoff. Various studies have found that urban heat islands can increase air temperatures in urban areas by 2–4°C, compared to their surroundings, especially in arid and semi-arid regions[35]. More frequent extreme weather events will expose urban areas to even greater risks. Cities currently account for more than 70% of global **energy demand** and are, on average, 5–9°C warmer than rural areas[36].

Urban green spaces and forests are the EbA solutions most frequently used to address climate change and biodiversity goals together. These generally encompass large areas, show high potential for carbon sequestration and adaptation, and are frequently located in peri-urban areas. Other NbS that address climate change whilst also favouring biodiversity include the restoration of green corridors or brownfields, green roofs, sustainable urban drainage systems and the re-naturalisation of rivers and wetlands.

Using EbA solutions to expand green spaces in cities can reduce their vulnerability to heat waves. Common options are **urban parks and forests**, street trees, ground vegetation as well as **green roofs and facades**, all of which help reduce air temperatures through evapotranspiration and increased shade. Green spaces offer other benefits as well, including **reduced surface water run-off,** which lowers the risk of floods (as in 'sponge cities'). These spaces also reduce energy demand for cooling, thus lowering GHG emissions, sequestering carbon and improving air quality, whilst enhancing **aesthetic and recreational value,** cultural services as well as biodiversity.

CASE STUDY

Jordan: The role of green infrastructure in creating an urban microclimate, achieving energy efficiency and enhancing biodiversity in Amman

With about **80% of its population concentrated in urban areas**, Jordan urgently needs to apply innovative adaptation interventions on a large scale to enhance urban resilience.

In the adaptation section of its updated NDC, Jordan covers EbA solutions extensively. It gives particular attention to green infrastructure and community participation in ecosystem rehabilitation to address the impacts of heat waves in cities. **Green infrastructure** has proven to be an effective tool for building resilience in urban areas. Key measures under this NDC objective include the restoration of urban and peri-urban forests, with strong emphasis on community-based green infrastructure. NDC actions include (i) introducing climate-responsive building techniques to reduce the effect of heat and thus lower energy demand for cooling, and (ii) developing recreational parks under the management of **community-based organisations (CBOs)**. With this innovative focus on local institutions and CBOs, Jordan's NDC reflects a systemic approach relying on **social-natural interlinkages** as well as aspects of climate justice.

Jordan has plans for increasing the adaptive capacity of cities by planting trees and creating green spaces. For example, the **Amman Resilience Strategy** (2018)[37] for the city of Amman, the nation's capital, relies on five main pillars 'to become an integrated, smart, environmentally proactive, innovative, prosperous, young, equal, proud, and united city'. The strategy includes a total of 16 goals and 54 related actions designed to help the city achieve resilience. It is reinforced by the Amman Climate Plan (2019)[38] and the Vision for 2050 Amman Climate Action Plan[39].

The strategy involves promoting EbA solutions, such as the restoration of degraded urban ecosystems and creation of green areas, which contribute in various ways, compared with conventional urban approaches, to **climate adaptation:**

- Creating a **microclimate with a cooling effect** in open spaces and surrounding built-up areas, which reduces the urban heat island effect in areas adjacent to green spaces[40] (Individual trees have the potential to reduce heat by 12–16°C, and a cluster of trees can lower temperatures by 12.5–14.5°C[41].)
- Providing wind protection and reducing water runoff (the **sponge effect)** from parks to lower flood risks
- Providing **health benefits** from improved air quality and recreational spaces

→ Cities: Creating synergies between adaptation, mitigation and biodiversity

EbA solutions that enhance green spaces and restore ecosystems to reduce the heat island effect in urban areas also have the potential to enhance both mitigation and biodiversity conservation.

Box 6: Jordan – Synergies in the urban sector

ADAPTATION
Reduced heat island effect, lower flooding risk and increased urban resilience

MITIGATION
Lower energy demand for cooling and thus reduced GHG emissions

BIODIVERSITY
Enhanced urban/peri-urban ecological corridors, which support species and habitat diversity as well as ecological functions, thus helping maintain or restore multiple ecosystem services for human well-being

SOCIETY
Enhanced health and quality of life, stronger food and water security, and reduced costs of energy and disaster recovery

Green areas in cities help reduce energy demand for cooling, thus reducing GHG emissions. As extreme climate conditions become more frequent and intense, energy demand for heating and especially cooling is rising. The increased need for cooling is especially pronounced where the urban heat island effect poses a risk. To control the temperature in buildings, energy is used for cooling units (which are often very energy inefficient), contributing to GHG emissions.

Energy efficiency is directly linked with reductions in the urban heat island. EbA solutions, such as planting trees and creating green spaces, can ameliorate the urban heat island and thus help increase energy efficiency, reduce energy demand and lower the GHG emissions of cities.

Restoring degraded urban ecosystems and creating green areas improves functional connectivity and offers multiple opportunities to enhance biodiversity, through pollination, the attraction of bird species to urban areas and conservation/restoration of rural-urban nature corridors. For example, growing native wildflowers in park grasslands, open spaces, roadside ditches and even graveyards provides habitats and food for insects, bees and other pollinators. Green roofs and facades, with their ability to support multiple taxa and connect with other green spaces, provide important habitats for insect species and birds. Urban green areas may create 'green micro-corridors' and thus enhance genetic and species diversity, and functional connectivity between inner-urban as well as urban and rural areas.

The green infrastructure approaches proposed in Jordan's NDC have great potential to increase the quality of life for city dwellers by reducing the risk of flooding, decreasing energy consumption and the cost of living, whilst enhancing health as well as food and water security. The most vulnerable segments of the urban population will feel the impacts of climate change most strongly. Land use planning that addresses climate change impacts and fosters the maintenance of ecosystem services is thus vital for local communities in urban areas. Reducing heat and flood risks can lower the cost of cooling and minimise the costs of recovery from damage caused by flooding. Promoting activities such as rainwater harvesting and rooftop farming can strengthen food and water security, contributing to both SDG 2 (zero hunger) and 6 (clean water and sanitation).

Potential synergies with the GBF: Measures outlined in the NDCs should contribute directly to improved access to and benefits from green and blue spaces for human health and well-being in urban areas, as outlined in the new GBF (target 12). By increasing resilience to flooding and heat waves, these measures should also contribute directly to protection from hazards and extreme events (target 11) as well as to climate change adaptation (target 8) in the new GBF. As local plans develop these measures in greater detail, they may serve as examples of how to integrate biodiversity values into policies and planning **at all levels** of government (target 14).

4. Addressing maladaptation risks and potential negative impacts

Human and natural systems are complex, and so are their interlinkages. Thus, whilst it is easy to talk about how climate policies can create co-benefits for biodiversity and society (or conversely, how biodiversity can deliver co-benefits for the climate), this is clearly not enough. National policies must look beyond co-benefits and acknowledge that these interactions can also have negative impacts, posing threats that must be addressed (see Figure 2).

As the IPCC states in its Sixth Assessment report, 'climate change impacts and risks are becoming increasingly complex and more difficult to manage. Multiple climate hazards will occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in compounding overall risk and risks cascading across sectors and regions.' Addressing such threats requires a close examination of how one impact might result in another, which then impacts something else and eventually affects the planned activities. In this paper, we refer to these as 'impact pathways'. Regardless of the terms used ('cascading and complex risk, impact pathways or feedback mechanism), a **systems perspective** is required to address these threats effectively.

Take, for example, Jordan's proposal to expand urban green spaces as a means of increasing resilience to floods and heat waves. This measure might also lower average temperatures, thus reducing energy demand for cooling. In other words, it would contribute to mitigation not only by sequestering carbon in biomass but by lowering GHG emissions. This illustrates synergy between adaptation and mitigation but also shows how such measures can deliver socio-economic benefits. Some households may reduce their expenditures for cooling; even poorer ones that cannot afford air conditioning might still see improvement in their quality of life due to lower temperatures. This might improve people's livelihoods and perhaps slightly **increase their resilience**. These are all positive impacts. But negative ones can result as well, leading to maladaptation, ecosystem damage, GHG emissions or negative social impacts 'down the road'.

A full analysis of potential positive and negative impact pathways is beyond the scope of this paper. What we can do is give examples showing how different processes might be linked. For this purpose, the GIZ team co-authoring this paper brainstormed the example of urban green

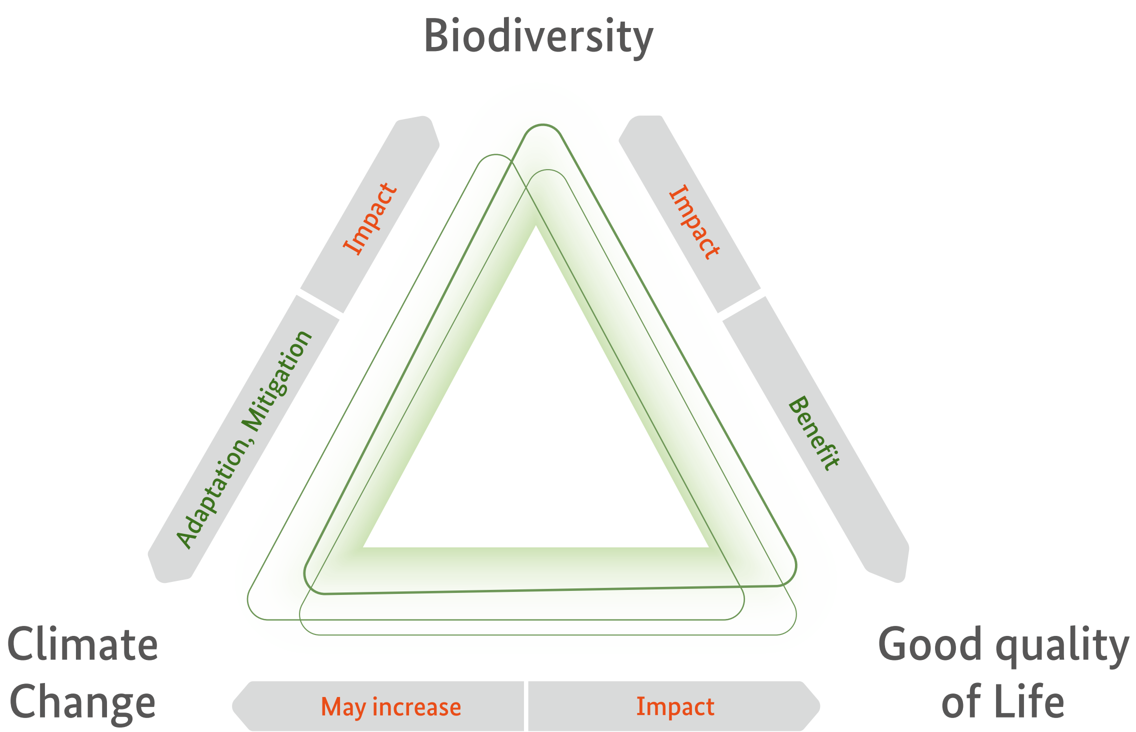


Figure 2: Interlinkages between climate change, biodiversity loss and quality of life (adopted from IPBES, 2021)

spaces, focusing on potential positive and negative impact chains[42]. The resulting mind map (see Figure 3) illustrates how one can start a discussion about negative impacts and maladaptation risks. It is meant as an 'invitation' not just to view synergies between climate and biodiversity as clear 'win-win' measures but rather to examine potential impact chains more closely, particularly the potentially negative ones. If we are to think and act on a wider basis than short-term quantifiable gains, we must look beyond an environmental perspective to consider potential **social and economic implications**.

In our case study on Amman, Jordan (see section 3), the main ecosystem services provided by green spaces, as outlined in the NDC, consist of reduced heat island effects and flood risks. This measure also relies on rainwater harvesting to strengthen water security, and promotes urban and rooftop farming to bolster food security. In addition, the expansion of recreational green spaces enhances quality of life, not only by improving air quality but also by helping people cope with stress,. Both climate and biodiversity frameworks recognise that increasing the quantity and quality of urban green spaces contributes to human well-being.

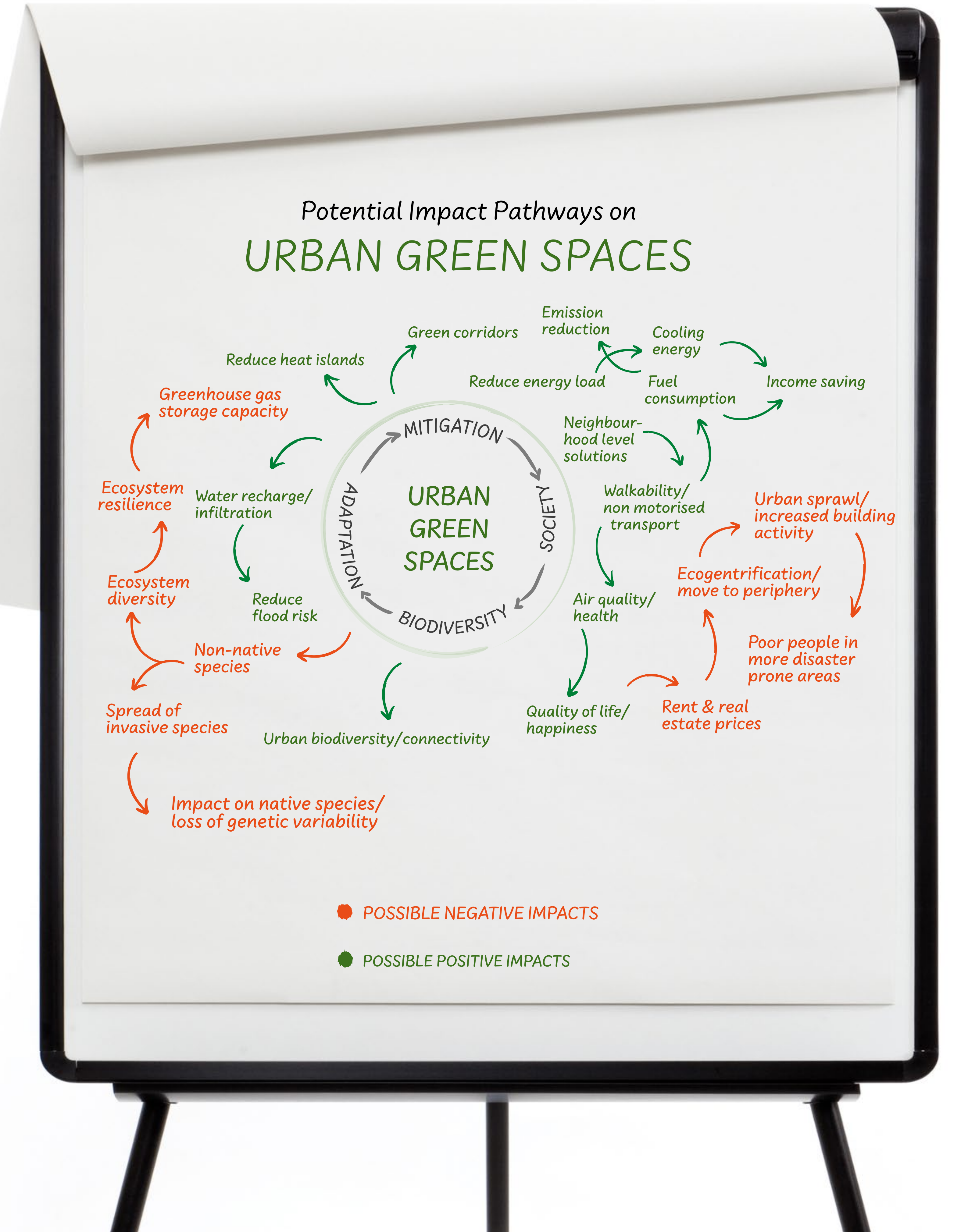
But increased quality of life, resulting from more green spaces, might also make previously unattractive urban areas more appealing. This could impact the real-estate market, driving up rent and sales prices (and raising their hedonic value). Moreover, through a process referred to as **eco-gentrification**, poorer members of the community could eventually be driven from their neighbourhoods into marginalised and possibly more disaster-prone areas, where they face increased vulnerability to climate and other hazards[43]. In the long term, impact pathways might thus **increase social injustice** along with other negative consequences. Eco-gentrification might even worsen ecosystem damage, as a result of urban sprawl.

One way to counteract such negative impacts is to establish CBOs. As proposed in Jordan's NDC, these organisations are expected to play a key role in identifying and defining the response to climate risks. They will also be closely involved in establishing, developing and managing recreational parks. Municipal institutions will be restructured accordingly and capacities built to ensure that CBOs form an integral part of the system (with potential to bring about systemic change in the entire socioecological setting).

Almost any adaptation measure poses the risk of maladaptation, underlining the need to tailor such measures to the local context. In the Pakistan case of wetland restoration to reduce flood risk, maladaptation risks could arise if EbA measures are implemented in areas with irrigated agriculture. Unless the policies, management plans and resource allocation mechanisms are clearly defined, increased availability of water might prompt farmers to expand irrigated agriculture. And this, in turn, might lead them to trade short-term gains for long-term losses, not only putting the positive impacts on biodiversity at risk through land-use change but also undermining long-term water security due to increased demand.

The case of silvopastoral systems in Costa Rica is especially prone to risk of maladaptation, unless the social, economic and ecological implications receive adequate consideration. Changes in agricultural systems can give rise to clashes with national conservation policies (e.g., on protected and conserved areas and the '30x30' goal of GBF[44]) or with social policies and equity aspirations. Recognising customary tenure and access rights are fundamental for the long-term sustainability of silvopastoral systems. Otherwise, landowners have little incentive to adopt approaches that contribute to biodiversity and mitigation. Moreover, if farmers lack the knowledge or capacity to manage such systems, this might lower productivity, harming farmers not only financially but indirectly through weakened food security. A further risk is that, even though locally adapted species strengthen ecosystem resilience, farmers might choose to plant non-native, fast-growing species such as pine trees or eucalyptus, which offer good revenues but would likely have negative impacts on local biodiversity. In the long-term, this might also increase land degradation, creating negative impacts for farmers through a negative feedback loop.

Figure 3: Impact pathways of urban green spaces (mind mapping). (Source: GIZ-EbA team workshop)



5. Where to go from here?

A discussion paper like this can provide only limited analysis. Consequently, we do not aim to cover all important aspects of the synergies between adaptation, mitigation, biodiversity conservation and human well-being. Rather, the point is that achieving the desired impacts requires a thorough analysis of synergies in all their complexity. In that spirit, we summarize some key points below:

1. Synergies between climate and biodiversity go beyond 'co-benefits'; they involve **interactions** (with both intentional as well as unintended effects) that require in-depth analysis, based on a systems perspective.
2. Synergies between climate and biodiversity conservation are not the same for adaptation as for mitigation and should thus be analysed separately, based on the **triple nexus** of mitigation-biodiversity, adaptation-biodiversity and mitigation-adaptation.
3. Any analysis of these synergies must take into account the '**human system**' (which we refer to as 'society' in this paper), involving climate justice, gender and intersectionality.
4. **Ecosystem-based approaches** have much potential to create synergies between adaptation, mitigation, biodiversity conservation and human well-being.
5. The targets of the new Global Biodiversity Framework offer a '**window of opportunity**' to explore synergies in the ecosystem-based approaches included in updated NDCs. This might not only **improve the coherence and alignment of national policies** and thereby strengthen governance but might also increase the chances for international support (e.g., access to **capacity building and finance)** and make measures more eligible for support from stakeholders in both climate and biodiversity conservation.
6. Any analysis of synergies should also try to identify potential **negative impacts** and address the risks of maladaptation. By helping **avoid maladaptation** and harmful, unexpected impacts later on, such an analysis can help enhance the **overall resilience of the social-ecological system** and ensure the **effectiveness** of the measures chosen**.**

This publication is intended as a contribution to the wider international discussion of synergies between adaptation, mitigation, biodiversity conservation and human well-being. In its recently published report[45], the IPCC focuses on **interactions amongst the coupled systems** of climate, ecosystems and human society, viewing these as sources of emerging risks but also as opportunities for creating a better future. The report further introduces the concept of 'climate-resilient development' in support of planetary health and human well-being. As shown in Figure 4, this development approach will require a thorough transformation of society and ecosystems to a more resilient state.

What might be the next steps, and what developments should we expect in the future?

Now that a new GBF has been adopted, countries will need to update their NBSAPs to align them with the new international biodiversity targets. We highly recommend that they review the ecosystem-based approaches in the NDCs, NAPs and other plans to ensure strong alignment between national climate and biodiversity policies. The update of the NDCs has yielded many lessons learnt, and the upcoming NBSAP process will likely generate many more.

Nature-based Solutions[46] continue to be a topic of debate, chiefly because of concerns that the private sector might misuse this concept for 'greenwashing'[47]. Nonetheless, studies show that NbS in NDCs actually benefit adaptation more than mitigation[48]. Some prefer to use the term 'ecosystem approaches', which is widely accepted by the CBD signatories. Ongoing debate underlines the need to create a shared understanding of the **many potential synergies between the climate and biodiversity agendas** and to strengthen these synergies, using the current window of opportunity in the best way possible. Focusing on synergies in adaptation and especially applying EbA measures might make these interventions less vulnerable to criticism, since they do not target the offsetting of emissions and therefore offer little scope for greenwashing. Additionally, internationally accepted definitions, guidelines[49] and knowledge products[50] already exist for EbA.

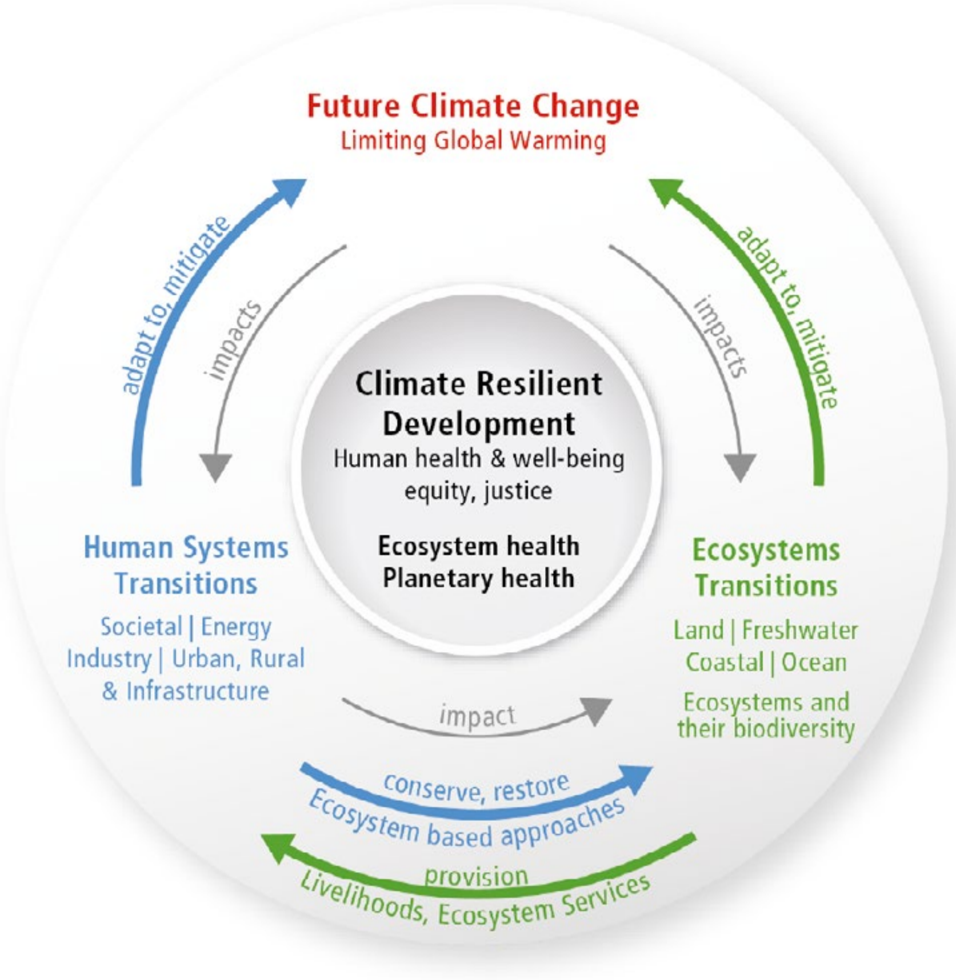


Figure 4: Climate-resilient development, as outlined by the IPCC. (Source: IPCC 2022)

It would be a mistake, however, to plan EbA solutions as standalone initiatives. Instead, NbS should be aligned with wider strategic priorities, as outlined in the updated NDCs but also in the Kunming-Montreal Global Biodiversity Framework and subsequently updated NBSAPs. This will help implement national priorities and also access funding lines and capacities already dedicated to climate change mitigation and adaptation, in addition to those earmarked for biodiversity conservation.

Both the climate and biodiversity agendas pay increasing attention to **longer term visions**, with 'long- term strategies' under UNFCCC and the Kunming-Montreal Global Goals for 2050 as a part of the GBF, both of which explore policy options for nearly the next 30 years. It is important to keep in mind that the impacts of ecosystem-based approaches have potential to grow over time – as **restored and recovering ecosystems** literally grow. However, these approaches might also face increasing uncertainty, since ecosystems can be severely affected by extreme climatic events, such as heat waves, droughts and wildfires. Taking this into account, the IPCC report (2022) points out that climate change might undermine the effectiveness of many EbA approaches[51]. This also holds true for many grey approaches. Either way, we must consider the **potential of ecosystem-based approaches to create synergy** from a long-term **2050 perspective** and prepare to mainstream them via **long-term policy agendas**.

References

Andrade, H. J.; Brook, R.; Ibrahim, M. (2008): Growth, production and carbon sequestration of silvopastoral systems with native timber species in the dry lowlands of Costa Rica. In Plant Soil 308 (1-2), pp. 11–22. DOI: 10.1007/s11104-008-9600-x.

Bartesaghi K.C.; Osmond, P.; Peters, A. (2018): Evaluating the cooling effects of green infrastructure: A systematic review of methods, indicators and data sources. In Solar Energy 166, pp. 486–508. DOI: 10.1016/j.solener.2018.03.008.

CBD (2022): Kunming-Montreal Global biodiversity framework. Available online at https://www.cbd.int/doc/c/e6d3/cd1d/daf663719a03902a9b116c34/cop-15-l-25-en.pdf Please not that a version of this paper published prior to COP15 was based on the first draft of the Global Biodiversity Framework as available online at https://www.cbd.int/doc/c/abb5/591f/2e46096d3f0330b08ce87a45/wg2020-03-03-en.pdf

Cole, H.S.V.; Lamarca, M. G.; Connolly, J. J. T.; Anguelovski, I. (2017): Are green cities healthy and equitable? Unpacking the relationship between health, green space and gentrification. In Journal of epidemiology and community health 71 (11), pp. 1118–1121. DOI: 10.1136/jech-2017-209201.

Dazé, A.; Terton, A.; Maass, M. (2018): Alignment to Advance Climate-Resilient Development. Overview Brief 1 Introduction to Alignment. Available online at https://www.iisd.org/publications/brief/alignment-advance-climate-resilient-development-overview-brief-1-introduction

Eckstein, D.; Winges, M.; Künzel, V.; Schäfer, L. (2019): Global Climate Risk Index 2020. Who Suffers Most from Extreme Weather Events? Weather-Related Loss Events in 2018 and 1999 to 2018. Bonn: Germanwatch Nord-Süd Initiative e.V.

European Commission, Directorate General for International Partnerships. Luna Rodríguez, M., Villate Rivera, R. (2022): Nature-based solutions in the NDCs of Latin American and Caribbean countries: classification of commitments for climate action, (Series of Technical Documents EUROCLIMA+ n.17)

Förster, J. (2022): Linkages Between Biodiversity and Climate Change and the Role of Science-Policy Practice Interfaces for Ensuring Coherent Policies and Actions. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), International Institute for Sustainable Development (IISD), Helmholtz Centre for Environmental Research (UFZ). Available online at https://www.adaptationcommunity.net/wp-content/uploads/2022/05/02-thematic-paper-linkages-biodiv-climate-science-policy-practice-giz-iisd-ufz.pdf

GCF (2019): Recharge Pakistan: Building Pakistan's Resilience to Climate Change through Ecosystem-Based Adaptation for Integrated Flood Risk Management. Available online at https://www.greenclimate.fund/sites/default/files/document/22620-recharge-pakistan-building-pakistan-s-resilience-climate-change-through-ecosystem-based.pdf

GIZ (2021): Integrating EbA and IWRM for climate-resilient water management. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn, Germany. Available online at https://www.adaptationcommunity.net/download/Integrating-EbA-and-IWRM_GIZ.pdf

Global Forest Coalition (2020): Action alert: join us to oppose nature-based solutions greenwash on International Day for Biological Diversity. Available online at https://globalforestcoalition.org/our-nature-is-not-your-solution

Government of Pakistan (2018): Pakistan National Biodiversity Strategy and Action Plan for achieving Aichi Biodiversity Targets and Sustainable Development Goals. Available online at https://www.cbd.int/doc/world/pk/pk-nbsap-v2-en.pdf

Government of Pakistan (2019): Pakistan's second national communication on climate change to UNFCCC. Available online at https://unfccc.int/sites/default/files/resource/183625_Pakistan-NC2-1-Pakistan%20-%20Second%20National%20Communication%20on%20Climate%20Change%202018.pdf

Government of Pakistan (2021): Updated Nationally Determined Contributions 2021. Available online at https://unfccc.int/sites/default/files/NDC/2022-06/Pakistan%20Updated%20NDC%202021.pdf.

Greater Amman Municipality (2019): The Amman Climate Plan: A vision for 2050 Amman. Available online at https://documents1.worldbank.org/curated/en/816961617187012025/pdf/The-Amman-Climate-Plan-A-Vision-for-2050-Amman.pdf

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES. (2018): The IPBES assessment report on land degradation and restoration.

IPBES (2022): Two New IPBES Assessments: Co-Chairs Announced & Work Begins on Nexus and Transformative Change Reports. Available online at https://ipbes.net/media_release/co-chairs_announced_and_work_begins_on_nexus_and_transformative_change_reports

IPCC (2019): Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Available online at https://www.ipcc.ch/site/assets/uploads/sites/4/2021/07/210714-IPCCJ7230-SRCCL-Complete-BOOK-HRES.pdf

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 [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

IUCN (2003): Nakivubo Swamp, Uganda: managing natural wetlands for their ecosystem services. Available online at https://www.yumpu.com/en/document/read/36132952/nakivubo-swamp-uganda-iucn

Koehorst, M. (2020): Sustainable Cities in China: Urban wetlands as nature-based solutions. Available online at https://panorama.solutions/en/solution/sustainable-cities-china-urban-wetlands-nature-based-solutions

Kurn, D.M.; Bretz, S.E.; Huang, B.; Akbari, H. (1994): The potential for reducing urban air temperatures and energy consumption through vegetative cooling.

OECD-FAO (2013): Agricultural Outlook 2013-2022. Available online at https://www.oecd.org/berlin/OECD-FAO%20Highlights_FINAL_with_Covers%20(3).pdf

Pörtner, H.O.; Roberts, D.C.; Poloczanska, E.S.; Mintenbeck, K.; Tignor, M.; A. Alegría, A. et al. (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. Available online at https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

Pörtner, H.O.; Scholes, R.J.; Agard, J.; Archer, E.; Arneth, A.; Bai, X. et al. (2021): Scientific outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change. DOI:10.5281/zenodo.4659158.

Resilience Cities Network (2022): Amman Resilience Strategy. Available online at https://resilientcitiesnetwork.org/downloadable_resources/Network/Amman-Resilience-Strategy-English.pdf

Richerzhagen, C.; Rodríguez de Francisco, J.C.; Weinsheimer, F.; Döhnert, A.; Kleiner, L.; Mayer, M. et al. (2019): Ecosystem-Based Adaptation Projects, More than just Adaptation: Analysis of Social Benefits and Costs in Colombia. In International journal of environmental research and public health 16 (21). DOI: 10.3390/ijerph16214248.

Secretariat of the Convention on Biological Diversity and the World Wide Fund for Nature (WWF) (2019). Opportunities in the water sector for integrating ecosystem-based approaches to climate change adaptation and disaster risk reduction. In: Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction and supplementary information. Secretariat of the Convention on Biological Diversity. Technical Series No. 93. Montreal, 156 pages. Available online at https://www.cbd.int/doc/publications/cbd-ts-93-en.pdf

Terton, A. (2022): Delivering Financing for Joint Biodiversity and Climate Solutions. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), International Institute for Sustainable Development (IISD), Helmholtz Centre for Environmental Research (UFZ). Available online at https://www.adaptationcommunity.net/wp-content/uploads/2022/05/06-thematic-paper-financing_biodiv-climate-solutions-giz-iisd-ufz.pdf

Terton, A. (2022): Nature-Based Solutions: An Approach for Joint Implementation of Climate and Biodiversity Commitments. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), International Institute for Sustainable Development (IISD), Helmholtz Centre for Environmental Research (UFZ). Available online at https://www.adaptationcommunity.net/wp-content/uploads/2022/05/03-thematic-paper-NbS-biodiv-climate-implementation-giz-iisd-ufz.pdf

Tsioumani, E. (2022): Linkages and Synergies Between International Instruments on Biodiversity and Climate Change. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), International Institute for Sustainable Development (IISD), Helmholtz Centre for Environmental Research (UFZ). Available online at https://www.adaptationcommunity.net/wp-content/uploads/2022/05/01-thematic-paper-synergies-biodiv-climate-instruments-giz-iisd-ufz.pdf

Turney, C.; Ausseil, A-G.; Broadhurst, L. (2020): Urgent need for an integrated policy framework for biodiversity loss and climate change. In Nature ecology & evolution 4 (8), p. 996. DOI: 10.1038/s41559-020-1242-2.

Wong, P. P.Y.; Lai, P. C.; Low, C. T.; Chen, S.; Hart, M. A. (2016): The impact of environmental and human factors on urban heat and microclimate variability. Available online at https://core.ac.uk/download/pdf/95554063.pdf

World Bank (2021): Pakistan: Blue Carbon Rapid Assessment - Policy Recommendations for the Revision of Nationally Determined Contribution. Washington, D.C.: The World Bank. Available online at https://openknowledge.worldbank.org/bitstream/handle/10986/35663/Pakistan-Blue-Carbon-Rapid-Assessment-Policy-Recommendations-for-the-Revision-of-Nationally-Determined-Contribution.pdf?sequence=1&isAllowed=y

WWF (2021): NDCs Increasingly Becoming a Force for Nature. Available online at https://wwf.panda.org/wwf_news/?4238891/NDCS-nature

UNEP (2022): UN Environment Assembly concludes with 14 resolutions to curb pollution, protect and restore nature worldwide. Available online at https://www.unep.org/news-and-stories/press-release/un-environment-assembly-concludes-14-resolutions-curb-pollution

Endnotes

1 IPBES (2018b). Summary for policymakers of the assessment report on land degradation and restoration. Rounsevell, M., Fischer, M., Torre-Marin Rando, A. and Mader, A. (eds), Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Bonn, Germany.

2 IPCC (2019). Climate and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems, https://www.ipcc.ch/report/srccl

3 Pörtner, H.O., Scholes, R.J., Agard, J., Archer, E., Arneth, A., Bai, X., Barnes, D., Burrows, M., Chan, L., Cheung, W. L., Diamond, S., Donatti, C., Duarte, C., Eisenhauer, N., Foden, W., Gasalla, M. A., Handa, C., Hickler, T., Hoegh-Guldberg, O. and Ngo, H.T. (2021). Scientific outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change. IPBES Secretariat, Bonn, Germany. Scientific outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change | Zenodo

4 A recent series of six thematic papers published through cooperation between GIZ, the International Institute for Sustainable Development (IISD) and Helmholtz Centre for Environmental Research (UFZ) provides an overview, explains the scientific basis and offers inspirational examples of synergies between biodiversity and climate change commitments. Thematic Paper 2: Linkages Between Biodiversity and Climate Change and the Role of Science-Policy-Practice Interfaces for Ensuring Coherent Policies and Actions – Adaptation Community https://zenodo.org/record/5101125#.YuP1jT3P270, https://www.adaptationcommunity.net/publications/thematic-paper-2-linkages-between-biodiversity-and-climate-change-and-the-role-of-science-policy-practice-interfaces-for-ensuring-coherent-policies-and-actions

5 Terton, A., Tsioumani, E., Förster, J. and Morchain, D. (2022). Synergies between biodiversity and climate-relevant policy frameworks and their implementation. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), International Institute for Sustainable Development (IISD), Helmholtz Centre for Environmental Research (UFZ). https://www.adaptationcommunity.net/wp-content/uploads/2022/05/01-thematic-paper-synergies-biodiv-climate-instruments-giz-iisd-ufz.pdf

6 UN Decade on Ecosystem Restoration, https://www.decadeonrestoration.org

7 UNEP https://www.unep.org/news-and-stories/press-release/un-environment-assembly-concludes-14-resolutions-curb-pollution

8 For more information on financing, see also see the thematic paper 'Delivering Financing for Joint Biodiversity and Climate Solutions'. https://www.adaptationcommunity.net/publications/thematic-paper-6-delivering-financing-for-joint-biodiversity-and-climate-solutions

9 For a general introduction to arguments for EbA in these sectors, see the GIZ-EbA publication (2022). Why working with nature pays off: The case for investing in Ecosystem-based Adaptation. https://www.adaptationcommunity.net/publications/why-working-with-nature-pays-off-the-case-for-investing-in-ecosystem-based-adaptation

10 For 'Recharge Pakistan', see https://www.greenclimate.fund/sites/default/files/document/22620-recharge-pakistan-building-pakistan-s-resilience-climate-change-through-ecosystem-based.pdf. For Jordan, see https://documents1.worldbank.org/curated/en/816961617187012025/pdf/The-Amman-Climate-Plan-A-Vision-for-2050-Amman.pdf

11 IPCC (2022) 6th Assessment Report on Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

12 In January 2022, two new IPBES assessments were announced to be 'among the most complex and interdisciplinary ever undertaken, with hundreds of leading international experts, from every region of the world, contributing as authors to the 3-year assessments. https://www.adaptationcommunity.net/publications/down-to-earth-why-soils-play-a-key-role-in-ecosystem-based-adaptation. Results will be presented in 2024.

13 For more information on EbA and soils, see the GIZ EbA publication (2022) 'Ecosystem soil: Down to earth – why soils play a key role in Ecosystem-based Adaptation'. https://www.adaptationcommunity.net/publications/down-to-earth-why-soils-play-a-key-role-in-ecosystem-based-adaptation

14 IISD and GIZ (2018). Alignment to Advance Climate-Resilient Development. Brief 1: Introduction to Alignment, https://www.iisd.org/publications/brief/alignment-advance-climate-resilient-development-overview-brief-1-introduction

15 Version as of March 2022 https://www.cbd.int/doc/c/abb5/591f/2e46096d3f0330b08ce87a45/wg2020-03-03-en.pdf

16 Please not that a previous version of this paper was based on the first draft on the GBF, version as of March 2022 available at https://panorama.solutions/en/solution/sustainable-cities-china-urban-wetlands-nature-based-solutions

17 For further information on integrated EbA in water resource management, see GIZ EbA publication (2020) "Integrating EbA and IWRM" https://www.adaptationcommunity.net/download/Integrating-EbA-and-IWRM_GIZ.pdf

18 See 'NDCs – a force for nature?' by WWF for more examples, https://wwf.panda.org/wwf_news/?4238891/NDCS-nature

19 2022 Pakistan floods - Wikipedia on 13 September 2022.

20 German Watch (2020). Climate risk index, https://germanwatch.org/sites/default/files/20-2-01e%20Global%20Climate%20Risk%20Index%202020_15.pdf

21 Government of Pakistan (2014). Quoted from 'Recharge Pakistan', GCF concept note, 22620-recharge-pakistan-building-pakistan-s-resilience-climate-change-through-ecosystem-based.pdf (greenclimate.fund)

22 Government of Pakistan (2019). Second National Communication on Climate Change to the UNFCCC

23 Government of Pakistan (2021). Updated Nationally Determined Contributions, https://unfccc.int/sites/default/files/NDC/2022-06/Pakistan%20Updated%20NDC%202021.pdf

24 See also GCF Concept Note (2019) https://www.greenclimate.fund/sites/default/files/document/22620-recharge-pakistan-building-pakistan-s-resilience-climate-change-through-ecosystem-based.pdf

25 World Bank (2021). Pakistan Blue Carbon Rapid Assessment, https://openknowledge.worldbank.org/bitstream/handle/10986/35663/Pakistan-Blue-Carbon-Rapid-Assessment-Policy-Recommendations-for-the-Revision-of-Nationally-Determined-Contribution.pdf?sequence=1&isAllowed=y

26 Pakistan's National Biodiversity Strategy and Action Plan (NBSAP, 2018), commits to establishing the protection of 15% of wetland areas with significant biodiversity by 2019, https://www.cbd.int/doc/world/pk/pk-nbsap-v2-en.pdf

27 See also GCF Concept Note (2019) https://www.greenclimate.fund/sites/default/files/document/22620-recharge-pakistan-building-pakistan-s-resilience-climate-change-through-ecosystem-based.pdf

28 See also MDPI (2019): Ecosystem-Based Adaptation Projects, More than just Adaptation: Analysis of Social Benefits and Costs in Colombia https://www.mdpi.com/1660-4601/16/21/4248

29 IUCN (2003). Nakivubo Swamp, Uganda: Managing natural wetlands for their ecosystem services, https://www.yumpu.com/en/document/read/36132952/nakivubo-swamp-uganda-iucn

30 OECD-FAO (2013). Agriculture Outlook 2013-2020, https://www.oecd.org/berlin/OECD-FAO%20Highlights_FINAL_with_Covers%20(3).pdf

31 Andrade et al. (2008). Growth, production and carbon sequestration of silvopastoral systems with native timber species in the dry lowlands of Costa Rica.

32 IPCC (2022) 6th Assessment Report on Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

33 IPCC (2022) 6th Assessment Report on Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

34 IPCC (2022) 6th Assessment Report on Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

35 Wong, P.P.Y., Lai, P.C., Low, C.T., Chen, S., Hart, M. (2016). The impact of environmental and human factors on urban heat and microclimate variability. Build Environ 95:199–208, https://www.sciencedirect.com/science/article/abs/pii/S0360132315301335

36 C40 (2016) Cool Cities – Good Practice Guide, https://www.c40.org/good-practice-guides

37 Amman Resilience Strategy, https://resilientcitiesnetwork.org/downloadable_resources/Network/Amman-Resilience-Strategy-English.pdf

38 Amman Cllimate Plan (2019). climate.pdf (amman.jo)

39 Vision for 2050 Amman Climate Action Plan (2019) https://documents1.worldbank.org/curated/en/816961617187012025/pdf/The-Amman-Climate-Plan-A-Vision-for-2050-Amman.pdf

40 Koc et.al (2018). Evaluating the cooling effects of green infrastructure: A systematic review of methods, indicators and data sources, https://www.researchgate.net/publication/324314761_Evaluating_the_cooling_effects_of_green_infrastructure_A_systematic_review_of_methods_indicators_and_data_sources

41 Kurn, D., Bretz, S., Huang, B. and Akbari, H. (1994). The potential for reducing urban air temperatures and energy consumption through vegetative cooling, https://www.aceee.org/files/proceedings/1994/data/papers/SS94_Panel4_Paper17.pdf

42 Note by the authors: This is not meant as a criticism of the country case outlined in section 3; on the contrary, we chose this case precisely because it addresses potential risks and societal impacts.

43 Cole HVS, Garcia Lamarca M, Connolly JJT, et al. 2017. Are green cities healthy and equitable? Unpacking the relationship between health, green space and gentrification J Epidemiol Community Health 2017;71:1118-1121.

44 IPCC (2022) 6th Assessment Report on Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

45 IPCC (2022) 6th Assessment Report on Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

46 For more on NbS, see also A. Terton (2022). 'Nature-Based Solutions: An Approach for Joint Implementation of Climate and Biodiversity Commitments', https://www.adaptationcommunity.net/wp-content/uploads/2022/05/03-thematic-paper-NbS-biodiv-climate-implementation-giz-iisd-ufz.pdf

47 See, for example, the 'Our Nature is not Your Solution' campaign driven by NGOs and many local and indigenous groups in 2020, https://globalforestcoalition.org/our-nature-is-not-your-solution

48 Based on data by the EuroClima+ program in latin America, unpublished. https://www.euroclima.org

49 Based on a study of updated NDC in Latin America by the EuroClima+ program, available at https://www.euroclima.org/seccion-publicaciones/tipo-de-documentos/doc-tecnicos-publicaciones/ultimas-publicaciones/full-report-nature-based-solutions-in-the-ndcs-of-latin-american-and-caribbean-countries-classification-of-commitments-for-climate-action

50 See Ecosystem-based Adaptation – Adaptation Community

51 IPCC (2022) 6th Assessment Report on Impacts, Adaptation and Vulnerability. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

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