

# → Why working with nature pays off

## The case for investing in Ecosystem-based Adaptation

If you are searching for sustainable and cost-efficient solutions to help you to adapt to climate change while also providing additional benefits, this brief offers you one clear option: Ecosystem-based Adaptation.

### WE HAVE ALL COME TO LEARN ...

that climate change is striking harder and more rapidly than many expected. The period of 2011–2020 has been the warmest decade on record. Of all disasters occurring during that time, 83% were caused by extreme weather- and climate-related events, such as floods, storms and heat waves. The number of such events has risen by almost 35% since the 1990s. Extreme weather caused USD 2.5 trillion in economic losses worldwide in the last two decades and took the lives of more than 410,000 people in the last decade alone, the vast majority in low-income and lower-middle-income countries. Extreme weather has displaced 20 million people per year in the last ten years – this is equivalent to the entire population of Beijing having to flee their homes every year.

We have all seen the shocking figures. But a key part of the solution to many of these problems is evident – in fact, it is lying on our doorstep.



### Ecosystem-based Adaptation (EbA)

Eba Criteria by FEBA (Based on CBD definition, 2009)

This brief is part of a **series of papers** on the evidence of the effectiveness of EbA as a type of Nature-based Solutions. Find out why EbA matters for **cities**, in the **water** and the **agricultural sectors**.



Nature across most of the globe has now been significantly altered by human activity: 75% of the land surface is significantly modified, 66% of the ocean area are experiencing impacts in the form of ecosystem decline, over 85% of wetland area has been lost, 32 million ha of forest in the tropics were lost (2010–2015) and one million species already face extinction. Achieving the Sustainable Development Goals (SDGs) will be nearly impossible if the current treatment of biodiversity and ecosystems persists. Their degradation undermines progress towards 35 of the 44 assessed SDG targets related to poverty, hunger, health, water, cities, climate, oceans and land. In 2020, the World Economic Forum called climate change a “planetary emergency”, for the first time in history ranking it (along with environmental issues such as biodiversity loss) as one of the top five global risks most likely to occur.



## DID YOU KNOW ...

that solutions based on nature can help protect us from climate change impacts while slowing further global warming, supporting biodiversity, and securing ecosystem services? Indeed, they can! Science has given us sufficient proof that well-managed ecosystems can protect communities from impacts such as storm surges, flooding, erosion, water scarcity, and low agricultural productivity. Because ecosystems help provide additional benefits such as diverse sources of nutrition and income, they can lessen the degree to which peoples' livelihoods are affected by climate change – when other livelihood sources fail in the face of extreme events.

Ecosystems are already the basis for half the global gross domestic product and 1.2 billion jobs in sectors as farming, fisheries, forestry, and tourism. Ecosystem services worldwide are worth an estimated USD 125 trillion annually. About 1.6 billion people rely directly on the world's forests for food, income, and livelihoods. Restoring our forests could provide adaptation benefits for more than 25 million people, and protecting our coastal ecosystems could benefit more than 500 million people globally, bringing benefits of over USD 100 billion per year. Increasing the extent of these ecosystems through restoration would amplify these effects.

Not only will these measures help people adapt to climate change, they can also significantly contribute to mitigating climate change by storing carbon and taking CO<sub>2</sub> out of the atmosphere. Restoring and better managing our global ecosystems has the potential to meet about 1/3 of GHG reduction needs until 2030 and to enable us to reach the targets of the Paris Agreement. But only if we manage to shift away from fossil fuels.



## OUR RELATIONSHIP WITH NATURE IS CRUCIAL IN ADAPTING TO CLIMATE CHANGE ...

This is why we need action inspired and supported by nature. Solutions that draw on the services humans derive from nature – i.e. biodiversity and ecosystems – are called Nature-based Solutions (NbS). The huge potential of NbS is now recognized by all the major international scientific bodies working on climate change and biodiversity. It is estimated that 90% of NbS support climate change adaptation.

Nature-based solutions for adaptation are also called Ecosystem-based Adaptation (EbA) – two terms, same meaning. EbA focuses on the protection of people, but this depends on healthy and well-managed ecosystems and biodiversity. Ecosystem conservation, restoration, and sustainable management are at its heart. EbA solutions exist for a broad range of climate change related problems, from increasing desertification to floods. They encompass solutions as diverse as ‘mangroves for coastal protection’ or ‘green roofs to improve urban climates’.

Already two out of three of the first national climate plans, i.e. Nationally Determined Contributions (NDC) to the Paris Agreement, feature EbA or NbS. Now we must put these plans into action.



Visit the Panorama platform to find more than 150 solutions for EbA.

PANORAMA PLATFORM





# So, why does EbA pay off?

Nature-based solutions can contribute one third of the GHG mitigation needed to meet the 1.5°C target.

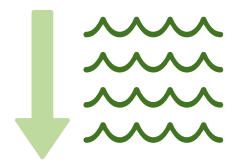
Long-term benefits of urban EbA and green-gray infrastructure usually outweigh initial investment costs by far.

EbA contributes to sustainable development, creating environmental, social and economic benefits.

EbA helps people to reduce climate-related risks that threaten their lives and livelihoods.

EbA measures help protect grey infrastructure and avoid costly damage, saving billions of dollars each year.

EbA contributes to “One Health”, creating benefits for human, animal and environmental health.



# 70%

reduction of  
wave heights

**EbA helps people to reduce climate-related risk that threaten their lives and livelihoods** by protecting and restoring the ecosystems upon which we all depend. Intact coral reefs and coastal vegetation can scatter waves and protect shores from erosion. Mangroves alone protect 18 million people worldwide from coastal flooding every year. Forested mountains and slopes can stabilize soil, providing protection from erosion and landslides. Peatlands, marshes, and floodplains balance out floods and water scarcity, and natural coastal ecosystems like corals reefs and salt marshes protect coasts by reducing wave heights by 70%.

**EbA avoids costly damage to assets and infrastructure**, saving billions of dollars each year. The City of Portland, USA, saved USD 250 million in stormwater infrastructure costs by investing USD 8 million in green alleys and tree plantations, which absorbed water and prevented flooding. The cost of flood damage that mangroves avert totals roughly USD 80 billion per year. In Korea, decades of investment in afforestation has created jobs and yielded an estimated net present value of over USD 50 billion in 2010, thanks to a significant reduction of disaster risk and an increase in carbon sequestration.



# 2–5 times

more cost-effective  
than grey infrastructure  
measures

**EbA often outperforms built infrastructure with respect to effectiveness and cost-efficiency.** Comparisons between conventional ('grey') and 'green' infrastructure solutions show that EbA measures achieved a 10% higher reduction of flooding and a 7.5% higher reduction of peak flow. Their typically lower initial price, minor maintenance costs and longer lifetime make them the more cost-efficient alternative. In a comparison of 52 coastal defence projects in the US, for example, NbS were estimated to be 2–5 times more cost-effective than grey infrastructure measures. Additionally, while built infrastructure deteriorates slowly, many ecosystem measures grow denser, stronger, and thus more resilient over time. However, oftentimes there is no green alternative to built infrastructure or hybrid solutions, in which case a mix of green and grey infrastructure works best.



**EbA investments save money over the long term.** Future benefits by far outweigh the investment costs of ecosystem restoration. The benefit-cost ratio may be as high as 3 to 75 depending on the ecosystem. Each dollar invested in the restoration of ecosystems to regenerate farmland, for example, is estimated to yield USD 7 to USD 30 in benefits for every dollar invested. When combined with built infrastructure, EbA measures can serve to prolong their lifetime and reduce maintenance costs. The restoration of 12,000 ha of mangroves in Vietnam, for instance, reduced dyke maintenance costs by about USD 7.3 million/year, making this investment more than 6½ times worth its initial costs.







**EbA measures come with numerous environmental, economic, and social (co-)benefits**, many of which are often particularly important for Indigenous peoples, local communities and women who rely on natural resources. As much as USD 40–50 billion per year in benefits associated with fisheries, forestry, and recreation is provided by mangrove forests. As EbA measures are in part labour-intensive, they can contribute to job creation immediately and in the long term. In line with the EU 2020 Biodiversity Strategy, it is estimated that restoring 15% of the degraded ecosystems in the European Union would create 20,000 to 70,000 full-time jobs. Ecosystem-based measures are therefore no- or low-regret measures that bring co-benefits to local development, no matter what the exact scale of climate change impact may be.

**EbA implementation also provides benefits for climate change mitigation** through the reduction or sequestration of greenhouse gases. Terrestrial ecosystems currently absorb about 20% of greenhouse gas emissions by human activities and have the potential to contribute more than 1/3 of climate change mitigation needs. Combining both adaptation and mitigation, as in the restoration of wetlands to absorb extreme rainfall events and store greenhouse gases, can therefore address two of the most pressing global challenges with the same action.

**EbA helps communities to cope with the COVID-19 pandemic and support “building back better”**. The pandemic highlights the critical connections between human and ecosystem health. In fact, the same human activities that drive climate change and biodiversity loss also drive pandemic risk through their impacts on our environment. Ecosystem restoration, which is at the heart of EbA, can help humanity to become more resilient. It can provide green jobs and economic recovery to communities in the short term, and over the long term restoration can lower the vulnerability of ecosystems and communities, increasing their health, livelihoods, and well-being. In coastal Honduras, for instance, community-led ‘no-take’ marine reserves are helping to replenish fish stocks and thus provide alternative sources of livelihood and nutrition in the face of climate change and other shocks. During the pandemic, when supply chains were disrupted, small-scale fisheries have become a critical safety net for thousands of Honduran coastal families who depend on them for daily sustenance.



Hazard	Ecosystem-based Adaptation	Potential additional benefits
 <p><b>Coastal hazards</b></p> <ul style="list-style-type: none"> <li>• Sea level rise</li> <li>• Storm surge</li> <li>• Coastal erosion</li> </ul>	<ul style="list-style-type: none"> <li>→ Mangrove protection and restoration to anchor sediments and dissipate wave energy</li> <li>→ Management and restoration of coastal marshes and/or dunes to dissipate wave energy and/or complement engineered protection</li> <li>→ Coral reef management and restoration to attenuate wave energy</li> </ul>	<ul style="list-style-type: none"> <li>→ Improved fish stocks</li> <li>→ Biodiversity conservation</li> <li>→ Carbon sequestration and storage</li> <li>→ Sediment accretion</li> <li>→ Tourism and recreation and associated employment</li> </ul>
 <p><b>Intense precipitation</b></p> <ul style="list-style-type: none"> <li>• Flood</li> <li>• Soil erosion</li> <li>• Landslide</li> </ul>	<ul style="list-style-type: none"> <li>→ Management and restoration of watershed vegetation to enhance infiltration, reduce run-off and peak flows, and stabilize slopes</li> <li>→ Agroforestry to enhance canopy interception of rainfall and rainwater infiltration and reduce soil exposure, thereby reducing run-off and erosion</li> <li>→ Urban watercourse restoration, and ‘re-naturing’ to reduce assets at risk and secure riverbanks</li> <li>→ Maintenance and restoration of urban greenspaces to improve rainwater infiltration and reduce run-off</li> <li>→ Management and restoration of wetlands to store floodwater or slow its release and filter sediments</li> </ul>	<ul style="list-style-type: none"> <li>→ Increased availability of wild-sourced food and other products</li> <li>→ Pollination services</li> <li>→ Carbon sequestration and storage</li> <li>→ Improved soil fertility</li> <li>→ Biodiversity conservation</li> <li>→ Improved water quality</li> <li>→ Improved physical and mental health among urban populations</li> </ul>
 <p><b>Drought</b></p>	<ul style="list-style-type: none"> <li>→ Management and restoration of watershed vegetation to enhance infiltration, recharge groundwater stores and maintain surface water flows</li> <li>→ Establishment of ‘Green Belts’ to increase water availability, improve soil quality, provide shade and windbreaks</li> </ul>	<ul style="list-style-type: none"> <li>→ Increased availability of wild-sourced food and other products</li> <li>→ Pollination services</li> <li>→ Carbon sequestration and storage</li> <li>→ Improved soil fertility</li> <li>→ Biodiversity conservation</li> </ul>
 <p><b>Rising temperatures</b></p> <ul style="list-style-type: none"> <li>• Heat stress</li> <li>• Urban heat islands</li> <li>• Wildfire</li> </ul>	<ul style="list-style-type: none"> <li>→ Agroforestry to enhance canopy cover and provide shade</li> <li>→ Rehabilitation and restoration of rangelands to repair ecological processes and enhance fire resistance</li> <li>→ Creation of urban green spaces to increase vegetative canopies, which provide shade and evaporative cooling</li> </ul>	<ul style="list-style-type: none"> <li>→ Carbon sequestration and storage</li> <li>→ Improved soil fertility</li> <li>→ Biodiversity conservation</li> <li>→ Improved physical and mental health among urban populations</li> </ul>



## A LOOK AT ONE EXAMPLE OF SUCCESSFUL EBA

Peru's Nor Yauyos Cochas Landscape Reserve (NYCLR), located in the high-mountain Andean ecosystem, is characterized by montane grasslands and wetlands. This region is especially vulnerable to climate change as global warming melts glaciers, whose partial melting processes in summer have been a stable source of water for surrounding Andean communities. Now, their increased melting causes flooding and, once the glacier is melted, droughts. Another problem in mountainous areas are heavy rains, which can easily erode steep slopes and cause landslides, destroying houses and agricultural land.

To counter these threats and ensure the livelihoods of the local population, which depends on the mountain ecosystem for live-stock farming and subsistence agriculture, a [Mountain EbA project](#) was created by the Ministry of Environment of Peru, the National Service for Natural Protected Areas and the reserve authority together with the support of international organizations. Activities included capacity building, institutional strengthening, and community organization regarding pasture, water, and livestock management, as well as concrete EbA measures implemented in communities located in the reserve.

Micro-watersheds and wetlands were supported by restoring water channels and reservoirs to ensure fresh water for the habitants of the reservoir as well as for downstream users. This, combined with grassland management measures that stabilize the soil, store nutrients, and regulate water and humidify 800 hectares of natural pasture, can increase resilience to drought and frost and even protect the area from nearby [wildfires](#). Another positive effect is [increased carbon storage](#), which contributes to climate change mitigation.

On a local scale, the quality of pasture could be improved immensely. Whereas one hectare of pasture used to provide enough fodder for only half a sheep, it can now feed 18 sheep; this has helped to secure and improve pastoral livelihoods and local food security. Additionally, improved management of the locally adapted vicuña, a close relative of llamas and alpacas, provides local people with more of its fine, valuable wool.

Local residents evaluated the project positively, and economic analysis proved that the benefits created by EbA measures outweighed their costs. The benefit-to-cost ratio was always above two, indicating that the benefits are [twice as high](#) as implementation costs. Compared to business-as-usual scenarios, net present values were [3 times as high](#). These advantages, combined with social improvements such as an observed increase in participation, have led to the inclusion of EbA into local-level management plans, a [Regional Climate Change Strategy](#), and the [National Policy Guidelines for Public Investment in Biodiversity and Ecosystem Services 2015–2021](#).



Protection of mountain ecosystems can stabilize water availability and increase resilience to extreme events. © Rafael Iriarte / Sernanp



Improved management of the locally adapted vicuña secures local livelihoods. © Carlos Díaz Huertas / EbA Montaña / Sernanp



# Where to find more information

## Publications

- The Voluntary guidelines for the design and effective implementation of ecosystem-based approaches, issued by Secretariat of the Convention on Biological Diversity (CBD), [UNEP and GIZ](#) (2019) suggest a flexible framework for planning and implementing EbA and Disaster Risk Reduction initiatives.
- [Nature-based Solutions to Climate Change – Key messages for decision makers in 2021 and beyond](#), puts forward a set of guidelines designed to inform the planning, implementation, and evaluation of NbS initiatives.
- Making EbA effective – a framework for defining qualification criteria and quality standards (ENG, ESP, FR) is a Technical Paper by [GIZ, IUCN, and IIED](#) (2018) in the framework of the Friends of EbA network that provides a practical assessment framework for designing, implementing and monitoring EbA measures by proposing a set of 3 elements, 5 qualification criteria and 20 quality standards with example indicators.
- In its fifth edition, the Adaptation Gap Report 2020 by [UNEP, the UNEP DTU Partnership, and the World Adaptation Science Programme](#) (WASP) takes a look at the broader picture with regards to progress in planning for, financing and implementing adaptation – with a focus on NbS.
- The United Nations Office for Disaster Risk Reduction ([UNDRR](#)), in its report on Ecosystem-Based Disaster Risk Reduction: Implementing Nature-based Solutions for Resilience (2020), gives practical, how-to information on setting up and implementing NbS, especially for DRR that integrates adaptation to climate change.
- The Adapt now: a global call for leadership on climate resilience (2019) report by the [Global Center on Adaptation](#) focuses on making the case for climate adaptation, providing specific insights and recommendations in key sectors: food security, the natural environment, water, cities and urban areas, infrastructure, disaster risk management, and finance.
- Building Resilience With Nature – Maximizing ecosystem-based adaptation through National Adaptation Plan processes (2021) is a guidance note developed by the [National Adaptation Plan \(NAP\) Global Network](#). Network members identified the need to better understand and identify concrete entry points and opportunities to strengthen the integration of EbA into adaptation planning. The guidance note presents “why” and “how” the NAP process can be used as a key mechanism and driver to mainstream and upscale EbA.

## Initiatives and networks

- The [International EbA Community of Practice](#), convened by GIZ, engages researchers and practitioners in knowledge sharing and mutual learning on ecosystem-based approaches beyond projects, institutions and regional boundaries. Publications by GIZ’s Global Project on Mainstreaming EbA can be founded [here](#).
- [Friends of EbA \(FEBA\)](#) is a global collaborative network of 80+ agencies and organizations involved in the research and practice of EbA, working jointly to share experiences and knowledge, improve the implementation of activities on the ground, and to have a stronger and more strategic learning and policy influence on EbA.
- The platform [PANORAMA Solutions for a Healthy Planet](#) is a partnership initiative to document and promote examples of inspiring, replicable solutions across a range of conservation and sustainable development topics, enabling cross-sectoral learning and inspiration. EbA features as one of the pillars of this knowledge platform.
- The [Nature-based Solutions Evidence Platform](#) of the Nature-based Solutions Initiative of the University of Oxford is an interactive map linking NbS to climate change adaptation outcomes based on a systematic review of the peer-reviewed literature.





# → Why Ecosystem-based Adaptation matters for the water sector

If you are searching for sustainable and cost-efficient solutions for water security in the face of climate change, this brief makes the case for why you should integrate Ecosystem-based Adaptation to climate change into your work.

This brief is part of a **series of papers** on the evidence of the effectiveness of EbA as a type of Nature-based Solutions. Find out why EbA matters for **cities**, in the **water** and the **agricultural sectors**.



## CLIMATE CHANGE EXACERBATES WATER INSECURITY

Did you know that as of now, 80% of the global population's water security is at risk? The effects of a 2°C warmer climate would further aggravate this situation. Climate change combined with current trends in population growth and consumption patterns will make the already challenging task of providing enough water of adequate quality for consumption, sanitation, food production, and economic use increasingly impossible.

Equally, protection from water-related hazards will become more challenging, as many of the key climate change impacts will affect us through water. The water cycle will be altered by the changing climate everywhere: many humid regions will get even more rainfall, while dry regions will become dryer. Further, 90% of all disasters are water-related, (such as floods and droughts), and they are predicted to become more frequent, and more extreme, due to climate change.

Climate change also affects water quality – e.g. by impacting ecosystems like lakes, rivers, springs, and wetlands, which play an important role in storing and filtering freshwater. Protecting ecosystems therefore often protects safe access to clean water.

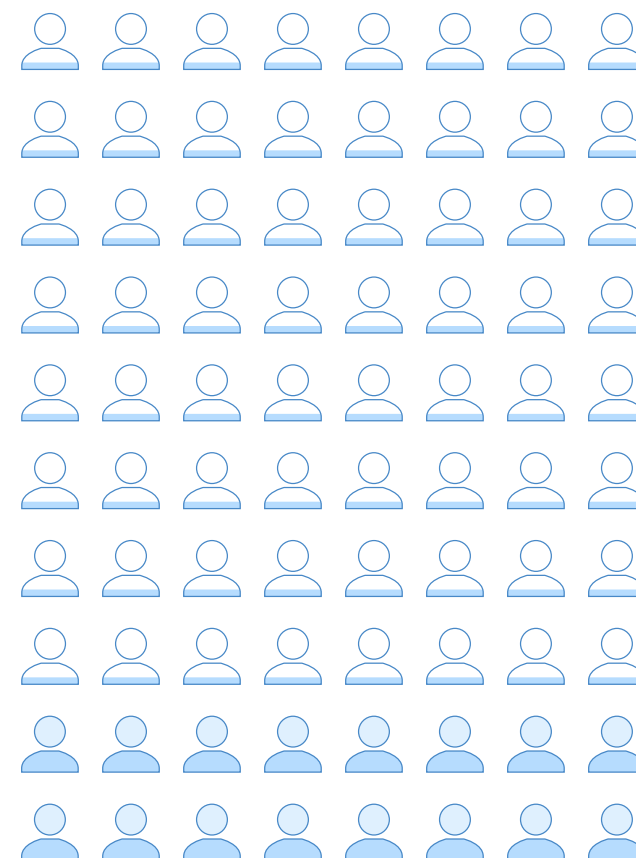
Ecosystems are at the centre of these changes. Their degradation is the main reason for an upsurge in water-related risks and extremes that destroy people's lives, livelihoods and (water and sanitation) infrastructure. Ecosystem-based solutions can help tackle and significantly reduce this risk.

## ECOSYSTEM-BASED ADAPTATION IS PART OF THE SOLUTION

Strengthening and protecting ecosystems is a powerful solution – for the sake of nature and human well-being. Ecosystem-based Adaptation (EbA) solutions use ecosystems and their services to protect people from the adverse effects of climate change. According to the World Water Development Report 2018, the water saved by widespread use of EbA could exceed the projected water demand for 2050, providing enough water for food security and other uses.

# 80%

of the world's population  
suffers serious threats  
to its water security

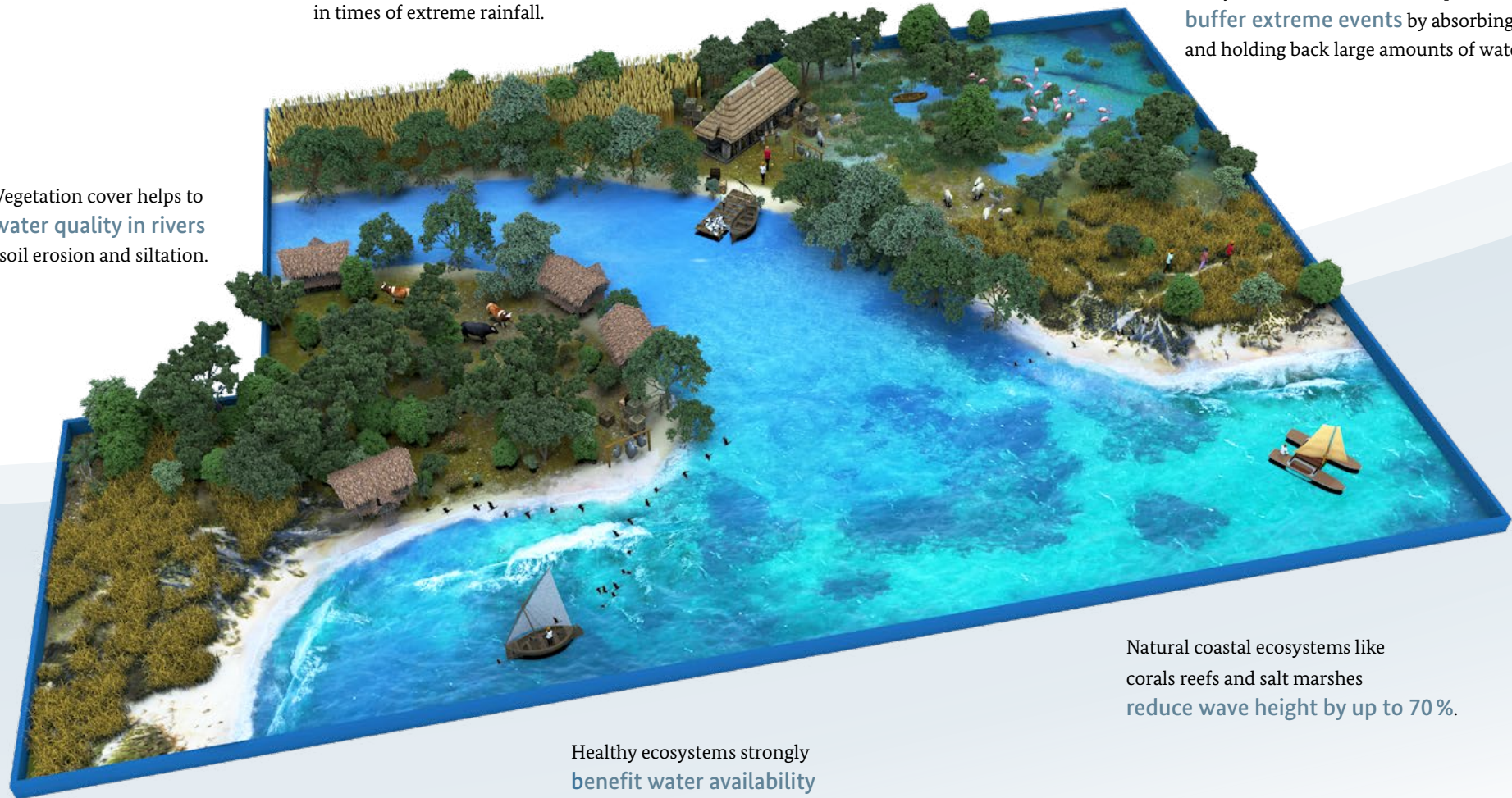


# What are the benefits of EbA in water management?

Reforestation of watersheds **lowers flood risk** in times of extreme rainfall.

Ecosystems like marshes and riparian forests **buffer extreme events** by absorbing and holding back large amounts of water.

Vegetation cover helps to **improve water quality in rivers** by reducing soil erosion and siltation.



Natural coastal ecosystems like corals reefs and salt marshes **reduce wave height by up to 70 %**.

Healthy ecosystems strongly **benefit water availability and security**.

Grasslands **absorb 50 to 80 % more water** than uncovered soil.



**Ecosystems are central to water provision, regulation, and quality.** Considering ecosystems in integrated watershed management ensures that their regulating services (storing and gradually releasing water during drier periods) can be protected or even increased. Grasslands can capture 50–80% more water than uncovered soil, well-managed inland water ecosystems like rivers and marshes can absorb and hold significant amounts of excessive water during extreme rain and flood events, and adequate reforestation of watersheds can lower stream flows during high precipitation cycles. In addition, water quality can be improved by ecosystems buffer strips and ground cover help to prevent siltation in creeks and rivers.

**Ecosystems minimize the impacts of extreme weather events and climate variability – in a cost-effective way.** Natural coastal ecosystems like corals reefs and salt marshes can reduce wave heights by 70%. Such ecosystem-based approaches are often not only more effective, they are also 2–5 times more cost effective than engineered structures.

**EbA measures can provide co-benefits for local development, as well as mitigation of greenhouse gases.** One example from the Gulf of Mexico showed how supporting the natural recruitment of oyster reefs not only reduced vegetation retreat by 40% and stabilized the shoreline of the Gulf of Mexico from erosion, it also increased the number and variety of marketable oysters, thereby ensuring a sustainable livelihood for the local population.

The simultaneous reduction of greenhouse gas concentration through natural carbon stocks can be achieved with EbA measures such as restoring wetlands or reforesting upstream catchments. Terrestrial ecosystems have the capacity to absorb up to 1/3 of climate change mitigation needs, while at the same time regulating water flows and reducing risks.

**EbA measures pay off.** The Upper Tana-Nairobi Water Fund, for instance, expects a USD 10 million investment in watershed conservation activities (including EbA measures such as restoration of riparian buffers and reforestation) to translate into USD 21.5 million in savings from wastewater treatment, amplified power generation and improved agricultural yields. The measures also simultaneously ensure water provision for downstream residents in Nairobi, despite the threat of climate change.

**Including ecosystem-based approaches in water management plans can help leverage finance.** Investments in green infrastructure in the water sector are rising as the recognition for their cost-effectiveness grows. The evolving ‘green bond’ market, for example, indicates potential for mobilizing green financing, and the investments of governments, water utilities and companies in nature-based ways to sustainably provide water are increasing at an annual rate of more than 11%.

**EbA can improve “pandemic preparedness”.** Because one of the main measures against the Covid-19 pandemic is regular hand-washing, the importance of water for hygiene and health has returned to the spotlight. Ecosystem-based measures can play a vital role in ensuring global water security in terms of availability and quality, thus laying an important foundation for countering health crises worldwide.

EbA measures	Environmental benefit	Risk reduction benefit	Socio-economic benefit
<b>Green infrastructure (green roofs, porous pavements, parks) in urban areas and hinterland</b>	Improved microclimate and habitat for urban species	Flood protection, reduction of extreme weather event risks	Risk reduction for people and infrastructure, new recreation areas, improved well-being, new employment opportunities
<b>Landscape and watershed management, river basin management</b>	Improved water provisioning and regulation, carbon sequestration, habitats	Flood protection, drought risk reduction	Improved water provisioning and quality, for consumption, sanitation and production sectors
<b>Restoration of wetlands, artificial wetlands</b>	Improved water provisioning and regulation, reduced carbon emissions and higher sequestration, habitats	Flood protection, drought risk reduction, storm buffering	Improved water provision and quality
<b>Restoration of flood plains</b>	Improved water regulation, erosion prevention, habitats	Flood protection	Risk reduction for people, infrastructure and industry, improved water provision and quality

Table 1: Typical ecosystem-based measures within the water sector (SCBD, 2019 )

## EBA IN PRACTICE IN THE WATER SECTOR: THE UPPER TANA-NAIROBI WATER FUND TRUST

The Tana River located in Eastern Africa is immensely important for Kenya. It provides **water for 9 million people** – including 4 million in the capital city of Nairobi – delivers **water to the 300,000 farmers** in a very important agricultural production area along the river, and generates **50% of Kenya's hydropower** output.

Changing rainfall patterns due to climate change threaten all of these uses of the Tana River. Reduced rainfall directly leads to less available water, yet extreme rainfall events also negatively affects water provision, as they wash away soil on the steep hills of the river's catchment area, destroying farmland and clogging water distribution and power generation facilities with sediment.

The Upper Tana-Nairobi Water Fund (UTNWF) was established as a public-private partnership, which brings together responsible politicians and water company leaders to ensure continuous water provision, including for residents of Nairobi downstream, in the face of challenges like climate change and unsustainable farming in the river catchment system.

The fund developed a business case and analysis, which found that a USD 10 million investment in water fund-led conservation interventions is likely to return USD 21.5 million in economic benefits within 30 years.

### The predicted benefits include:

- improved water quality;
- a 15% increase in annual water yields during dry season;
- only half the amount of sediment in the river;
- an increase of over USD 600,000 in annual revenue for Kenya's electricity company due to increased power generation;
- savings of approximately USD 250,000 by the Nairobi City Water and Sewerage Company for avoided filtration costs.



EbA measures such as reforestation help to ensure future water provision. © Bobby Neptune / The Nature Conservancy strategy



The use of nature and ecosystems can help to improve water availability and water quality. © Roshni Lodhia / The Nature Conservancy

A simulation model for the Tana River Basin system was established to investigate how best to ensure water provision: by changing the existing engineered infrastructure, constructing new dams and tunnels, or investing in natural infrastructure. The results showed that **the use of nature, ecosystems and biodiversity could very well ensure future water provision** and also provide **more than USD 170 million in co-benefits per year** through fisheries, flood recession agriculture, floodplain cattle grazing, etc. This would benefit mainly subsistence smallholder farmers and pastoralists in the river basin. Consequently, the fund invested in training and equipping farmers with everything they need to apply EbA measures such as vegetated buffer zones along riverbanks, terracing, agroforestry, reforestation, and water harvesting to ensure the provision of water for all uses and users.





# Where to find more information

## Publications

- Integrating EbA and IWRM for climate-resilient water management, [GIZ](#) (2021) – an exploration of how the two leading approaches in water resources management and ecosystem thinking for climate change adaptation (IWRM and EbA) can be merged to achieve greater climate resilience in watersheds.
- Stop Floating, Start Swimming: Water & Climate Change – Interlinkages & Prospects for future Action, [GIZ](#) (2020) – aims to improve understandings of the complex interrelations between climate change and water.
- Nature-based solutions for adapting to water-related climate risks, [OECD](#) (2020) – explores why prevailing decision making frameworks may fail to adequately consider NbS. Focusing on the application of NbS for addressing climate-related flood and drought risks, this paper sets out a policy evaluation framework that supports the identification of, and proposed ways to address constraints on the use of NbS to address water-related climate risks.
- Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction and supplementary information, [SCBD](#) (2019) – provide detailed information on considerations for EbA and Eco-DRR, the respective principles and safeguards as well as implementation issues (including mainstreaming, awareness raising and capacity building). It also includes a part dedicated to [Outreach into Sectors](#), including water.
- The United Nations world water development report 2021: valuing water, [UNESCO](#) (2021) – assesses the current status of, and challenges to, the valuation of water across different sectors and perspectives, and identifies ways in which valuation can be promoted as a tool to help achieve sustainability.
- The United Nations World Water Development Report 2018: Nature-based Solutions for water, [UNWWDR](#) (2018) – demonstrates how NbS offer a vital means of moving beyond business-as-usual to address many of the world's water challenges while simultaneously delivering additional benefits vital to all aspects of sustainable development.

## Initiatives and networks

- [Global Water Partnership](#) is a global action network that provides knowledge and builds capacity to improve water management at all levels: global, regional, national and local.
- The [Alliance for Water Stewardship](#), a global membership collaboration comprising businesses, NGOs and the public sector, contributes to the sustainability of local water resources through the members' adoption and promotion of a universal framework for the sustainable use of water.
- The [Women for Water Partnership](#) is a partnership of women's organizations and networks that uses water as an entry point to women's empowerment and to improve equitable access to water for all, for all uses.
- The [Alliance for Global Water Adaptation](#) is a member-driven global network to develop, crowd-source, and mainstream the emerging practice of climate resilience, especially with regard to water management.
- The [Water Integrity Network](#) focuses its work upon integrity and good governance to help realise the human rights to water and sanitation, boost sector performance, and ensure the sustainable use of water resources.



# → Why Ecosystem-based Adaptation matters for cities

If you are concerned about the impacts climate change will have on your city and looking for ways to make it more attractive for residents and businesses, this paper makes the case for why you should integrate Ecosystem-based Adaptation (EbA) to climate change into your work.

This brief is part of a **series of papers** on the evidence of the effectiveness of EbA as a type of Nature-based Solutions. Find out why EbA matters for **cities**, in the **water** and the **agricultural sectors**.



## CITIES ARE BOTH DRIVERS AND VICTIMS OF CLIMATE CHANGE

Did you know that **75%** of global greenhouse gas emissions are produced in and by cities, especially through buildings and transport? At the same time, cities are especially vulnerable to climate change impacts. Around **70%** of all cities are already facing negative effects of climate change, and nearly all are at risk – some even face existential threats. Those who suffer most are residents living in poor housing in unsafe locations. Heatwaves, the deadliest climate risk in cities, cause mortality rates of nearly **15%** above normal death rates, reduce workforce productivity, and damage infrastructure. Over **1.6 billion** people in nearly 1,000 cities will be affected by climate change in 2050, and its consequences will cost cities more than **10%** of their GDP by 2100. Sea level rise and coastal flooding will threaten over 800 million people and the infrastructure they depend on in nearly **600 cities** by 2050. The costs of sea-level rise could shoot up to **trillions of dollars** per year by 2100. The current **unsustainable growth** of cities, especially coastal cities in Africa and Asia, threatens natural ecosystems and the resources (e.g. biodiversity and water) that urban centres depend on. This is jeopardizing human well-being, and social and economic prosperity.

**75%**  
of global greenhouse  
gas emissions are  
produced in and by cities.

## ECOSYSTEM-BASED ADAPTATION IS PART OF THE SOLUTION

The important role of cities in contributing to climate change, combined with their immense susceptibility to its effects, highlight the need for sustainable urban planning, engineering, and construction. To tackle current and future challenges, working with nature rather than against it is often more resource-efficient, sustainable, and beneficial. Every dollar invested in adaptation can generate up to **10 dollars** in benefits. NbS for adaptation have the **potential** to restore natural resources, foster economic growth, create jobs, and improve human health and well-being.



# What are the benefits of EbA for cities?

Nature in cities provides recreational spaces and thus improves health, wellbeing and quality of life.

Green spaces counter the heat island effect and can cool cities by up to 15°C.

Green areas are important habitats to protect and increase biodiversity.

Urban green spaces improve air quality and reduce associated health costs.

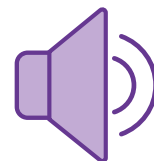
Ecosystems are essential for regulating water run-off in cities.



**EbA protects cities from disastrous climate change impacts in a cost-effective manner.** Ecosystems can regulate risks and buffer impacts in many ways, including through regulation of coastal and surface flooding, temperature regulation, and erosion control. Very often, it is cheaper and more efficient to use green infrastructure – or a combination of green and grey – than to rely on grey infrastructure alone. Ensuring that urban infrastructure is adapted to the effects of climate change can increase upfront costs by about 3%, and also generates benefits that outweigh costs by 4 times, on average. An analysis of 102 NbS implemented within the European Union showed that 50 of those solutions had recuperated investment costs within the first year.

**Green spaces cool cities and counter their 'heat island' effect.**

Increased temperatures and more frequent and intense heat waves are especially harmful for cities, which are on average 3–8°C warmer than surrounding rural areas. This so-called urban heat island effect is mainly caused by the heat emitted by buildings, industry, and transport, as well as by a lack of the shading and cooling effect of vegetation. The solution is, therefore, green. Tree canopy cover and well-irrigated grassed areas can lower surface temperature by around 15°C, green walls and roofs cool adjacent rooms by about 2°C, and green areas lower the urban heat island effect by 1°C, on average. This phenomenon is known as the 'park cool island effect'. Barcelona's efforts to increase tree coverage from 5% to 30% reduced temperatures so successfully that it saved USD 10 million in annual utility bills from air conditioning in buildings, and also improved air quality.



reduce noise  
up to  
**10 dB**



lower surface  
temperature by  
around  
**15°C**

**Plants prevent premature deaths caused by air pollution and smog.** Air pollution is a big problem in cities, where 80% of the urban population is exposed to unsafe air conditions. This causes seven million premature deaths yearly worldwide. This risk is even higher for residents of cities with more than 100,000 inhabitants in the Global South, where 97% of cities have air pollution problems. Air purification, an important ecosystem service, can help reduce this problem. The clean air provided by urban trees in the Chinese city of Guangzhou, for example, is estimated to create benefits worth an USD 9.2 million annually.

**EbA pays off for cities.** Green natural spaces and the positive reputation of a place that is adapted to climate change threats make a city interesting for investors and can boost the economy. Holding or purchasing spaces for renaturation and parks can be expensive, but the investment is beneficial for the city as a whole. A comparison between central business districts with and without high-quality tree canopies indicates that people spend about 10% more for goods and services in green surroundings. The same holds true for business: Singapore's strong reputation as an economic centre is partly attributed to its urban greenery, which is strategically developed to strengthen the city's beauty, lure investments, and foster further economic growth. This is a paying idea, given that adaptation measures can even have a positive impact on a city's credit rating by protecting or creating a safer environment for investments.



### Ecosystems are essential for regulating water run-off in cities.

Urban areas are characterized by a high degree of concrete that impedes water infiltration into the earth. This disturbance of the natural water cycle leads to heavier run-offs, which can cause flooding during heavy rain events. Ecosystem-based measures, such as Chicago's green roofs, can prevent cities from dangerous water flows by slowing stormwater run-off by 36%. Another relevant ecosystem service many cities depend on is water filtration. This service was analysed for Mumbai, where the decrease in forest cover proportionally increased the required water treatment costs. Even a deforestation rate of well below 1% leads to a rise in water treatment costs of about USD 50,000 per year.

### Urban EbA measures can function as carbon sinks that remove CO<sub>2</sub> from the atmosphere.

The planting of trees, restoration of wetlands around rivers, greening of roofs and facades, and other similar measures can capture and store greenhouse gases like CO<sub>2</sub> and Methane. For the Colombian city of Medellín, estimates predict a rate of CO<sub>2</sub> absorption of more than 160 tons per year for only one of its 30 green corridors (covering 65 hectares), which together help to reduce average city temperatures by 2°C. Overall, the potential of ecosystems, including urban ecosystems, to capture greenhouse gases is huge: They can achieve more than 1/3 of global climate change mitigation needs.

**Nature in cities makes people healthier and happier.** In addition to their cooling and air purifying effects, nature in cities provides a place for fitness and recreation; hospitalized patients are believed to heal faster if they have a view of nature, saving USD 93 million per year in healthcare costs. A similarly positive effect is observed regarding the noise reduction capacity of green facades and roofs. They can reduce noise up to 10 dB and are especially effective for air traffic noise. Psychologically, natural elements in cities are shown to decrease stress, encourage psychological rehabilitation, and contribute to higher life satisfaction. Greenery in cities, such as parks and urban gardens, increase people's sense of belonging and can encourage social cohesion.



**Habitat creation leads to resilient urban biodiversity.** Urban EbA measures provide habitat for plants and animals, thereby protecting and enriching biodiversity, ecosystem health, and the ability to provide cherished ecosystem services like water regulation or air purification. An example is the canal naturalization of Singapore's Bishan-Ang Mo Kio Park; changes in its bank-side vegetation increased the number of insects associated with clean water and encourage more complexity in both terrestrial and aquatic biodiversity. This is important, as a high level of biodiversity is more resilient to disturbances such as climate change, allowing ecosystems to survive and continue functioning.



## URBAN EBA IN PRACTICE: CLIMATE-PROOFING SOCIAL HOUSING LANDSCAPES IN LONDON

London, like so many other cities, is facing potentially harmful climate change impacts like extreme heat waves and floods. Increasingly heavy rainfalls are dangerous, as the capacity of the city's drainage systems is nearly exhausted. The worst climate change impacts are felt by poor people living in precarious housing conditions.

In three social housing areas in West London characterized by a high exposure to climate change risks and poverty, the charitable organization Groundwork London and the Hammersmith and Fulham Council started work to help residents adapt to the effects of climate change using nature.

Affordable, highly effective, and socially accepted measures formed a broad package that included:

- Rain garden combined with tree pit
- Residential and low-level green roofs
- Tree and shrub planting
- Resident planting/gardening areas
- Permeable paving
- Grassy basins.



Urban green areas provide recreational spaces and increase quality of life.  
© Jamie Street / unsplash.com

### The project realized impressive gains

- An average of 90% of the rainfall that lands on the green roofs is absorbed. Combined with the other measures, this diverts 1,286,815 litres of rainfall away from a challenged drainage system each year.
- The project was worth its investment: every £1 invested generated £4.39 of benefits.
- The vast majority of residents (80%) acknowledges a significant improvement in the quality of their surrounding green spaces.

Social activities included awareness-raising around climate change adaptation, community engagement, and training for local apprentices on how to implement and maintain the above measures.

Encouraged by their great success, the organizations have launched knowledge-sharing activities through resources on the project's website and international visits that foster exchange and discussion.



Green spaces allow natural infiltration of rainfall and take pressure of built drainage system. © Cherie Xiao / flickr





# Where to find more information

## Publications

- Practical Guide to implementing green-grey infrastructure, [Green-Gray Community of Practice](#) (2020) – provides information on combining nature-based and conventional (grey) infrastructure solutions.
- Strengthening blue-green infrastructure in our cities, [Dreiseitel and Wanschura \(2016\)](#) – offers information on the combination of green and blue infrastructure.
- The value of nature in urban life, [ICLEI](#) – a poster on the diverse life-supporting and life-enhancing contributions of nature to people in cities and surrounding areas.
- Nature-based Solutions to Climate Change Adaptation in Urban Areas: Linkages between Science, Policy and Practice, [Kabisch et al. \(2017\)](#) – brings together a wealth of knowledge on the effectiveness of NbS in addressing climate change adaptation from diverse but inter-related fields of study.
- Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction and supplementary information, [SCBD](#) (2019) – provide detailed information on considerations for EbA and Eco-DRR, their respective principles and safeguards, and implementation issues (including mainstreaming, awareness raising and capacity building). It also includes a section dedicated to [Outreach into Sectors](#), including infrastructure.

## Initiatives and networks

- The [Global Green-Gray Community of Practice](#), created in 2020, is an international group working to: innovate and pilot new green-grey approaches; expand science, engineering, and policy activity; increase awareness; and build a community that helps increase broad acceptance and enable access to finance.
- [C40](#) is a network of the world's megacities committed to addressing climate change. C40 supports cities to collaborate effectively, share knowledge, and drive meaningful, measurable, and sustainable action on climate change.
- [Climate-ADAPT](#) aims to support Europe in adapting to climate change, helping users to access and share data and information.
- [Building with Nature](#) is a design philosophy in which natural processes deliver a number of benefits such as protection against flooding and coastal erosion, and opportunities for nature and recreation.
- [ICLEI](#) – Local Governments for Sustainability is a global network of more than 2,500 local and regional governments committed to sustainable urban development.
- [Nature-based solutions: Transforming cities, enhancing well-being | European Commission](#) showcases nine EU-funded projects that address climate change challenges through NbS.





# → Why Ecosystem-based Adaptation matters for agriculture

If you are searching for sustainable and cost-efficient solutions for ensuring agricultural productivity in the face of climate change, this paper makes the case for why you should integrate Ecosystem-based Adaptation (EbA) into your work.

This brief is part of a **series of papers** on the evidence of the effectiveness of EbA as a type of Nature-based Solutions. Find out why EbA matters for **cities**, in the **water** and the **agricultural sectors**.



## AGRICULTURE: CAUSE, VICTIM, AND SOLUTION

Agriculture is strongly affected by climate change. Increased temperatures, weather extremes like droughts and floods, and sea level rise destroy harvests, lead to soil erosion and cause an accelerated spread of pests that threaten food production and food security. Yields of major cereal crops, including rice and wheat are expected to decline by 17% on average. The vulnerability of agricultural production – and of the 2.5 billion people who depend on it for their livelihoods – is obvious: the sector forms the basis of about half of the global GDP, yet it absorbs more than a quarter of the economic impact of climate disasters. This not only disproportionately affects smallholder farmers and low-income groups, it also endangers the business model for industrial agriculture, which in turn is the biggest individual contributor to global environmental change. It has already led to the degradation of one third of global soils, the loss of biodiversity and destruction of ecosystems, and is a major cause of climate change, emitting around one quarter of global greenhouse gases.

What can we do to reverse this trend? Structural change is needed to safeguard the natural resource base and the biodiversity we all depend on. *Sustainable agriculture* is at the heart of the solution, offering an alternative to industrial agriculture.

*Providing food for today's population without compromising future generations' needs.*

Sustainable approaches can increase resilience and food security while at the same time reducing greenhouse gas emissions now and in the future, as well as greatly contributing to achieving the United Nations' Sustainable Development Goals.

## ECOSYSTEM-BASED ADAPTATION IS PART OF THE SOLUTION

Ecosystem-based Adaptation (EbA) solutions use ecosystems and their services to protect people from the adverse effects of climate change. EbA in agriculture includes techniques that build on holistic, agroecological, and regenerative processes like agroforestry and crop rotation. They aim at providing food for today's population without compromising future generations' needs. *Sustainable agriculture* considers not only economic but also ecological and social aspects. It comprises approaches such as agroforestry, organic farming, agroecology, regenerative farming and permaculture – all practical ways to implement EbA in agriculture.





# What are the benefits of EbA in agriculture?

Ecosystem services like water provision, pollination and soil preservation are **essential** for sustainable food systems.

Organic agriculture **restores** degraded soils and avoids **GHG-Emissions** originated by conventional farming systems

Cover crops and shade trees **increase** soil moisture of farming systems and **protect** agricultural yields.

Organic agriculture **avoids** the economic and environmental costs of industrial farming systems.

Sustainable farming systems diversify production, **increase** food security and create additional income.





**Increased climate resilience of farming systems protects agricultural yields.** Healthy agro-ecosystems can buffer extreme weather events and allow for continued production even in adverse conditions. Cover crops and shade trees prevent soil from drying out in arid months and also protect plants from sun and wind in agroforestry systems – and these are just two examples of their major benefits. During a devastating hurricane in 1998 in Central America, cover crops and agroforestry protected diversified farming systems from the worst damage, with 50% less yield losses and faster recovery in production compared to nearby conventional farms.

**Securing agricultural foundations for the future.** The preservation of ecosystem services is a key aspect of EbA and is especially crucial for agriculture, as it depends on services like water provision, nutrient regulation, pest control and pollination. Evidence from organic farming shows beneficial effects such as producing healthier soils through increased organic matter and enhanced biological activity in soils; soil organic carbon is on average 14% higher than in conventionally farmed soil. Likewise, the positive effects of organic agriculture have been shown with regard to water quality, biodiversity, and pest control. Intercropping and the use of compost among Kenyan farmers, for example, decreased their water needs by 70–90%. This reduces pressure on water resources and allows them to be replenished.



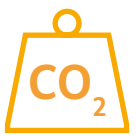
**Economic benefits at both national and local levels.** Sustainable farming practices are sometimes viewed as less economical. However, this is certainly not the case on a national scale. Taken together, the negative side effects of unsustainable agricultural practices evoke very high costs. Coping with the nitrate pollution caused by livestock mass production in Germany alone costs nearly 25 billion Euro annually. Initiatives like True Price advocate for the consideration of the complete economic picture. Comparisons assessing the total economic value of ecosystem services in conventional versus organic agriculture systems show evidence for a far higher total economic value with sustainable agriculture practices. On-farm, evidence shows the economic viability of sustainable farming approaches. Diversified farming systems, for example, ensure a circular model of resource use. Diversification decreases pests and diseases, and benefits plants in terms of availability of water, nutrients, and light. Comparisons of product output per farm, in particular, confirm the high productivity of agroecological farms. In financial terms, adopting sustainable land management could result in an increased crop production of USD 1.4 trillion.



**1.4**  
trillion \$  
through increased  
crop production



**Diversification and resulting social benefits.** Diversified production systems like agroforestry are less vulnerable. Their high diversity increases the chance that not all plants will suffer from pests and diseases, and strategic combinations of species can bring additional benefits such as shade or nutrients. At the same time, the use of fruit trees enriches farming families' diets and food security and provides extra income. For households that depend on firewood, agroforestry can also greatly shorten firewood collection time, for example in one case in Niger from 3 hours to 30 minutes. This is a significant relief for women who invest 60 to 90% of their time in food production and wood collection.

  
remove up to  
**51**  
gigatons  
of carbon dioxide  
from the atmosphere

**Avoidance and absorption of emissions.** A ban on agrochemicals like pesticides is an integral part of EbA and the agricultural systems in line with it. By avoiding agrochemicals and the greenhousegas emissions associated with their use, sustainable agricultural practices contribute to lowering emissions. In addition, the restoration of degraded agricultural soil has the potential to remove up to 51 gigatons of carbon dioxide from the atmosphere and store it in natural sinks. Convinced by these advantages, the “4 per 1000” Initiative (4p1000) advocates for an annual increase of soil organic carbon stocks of 0.4%, as they are natural carbon sinks. This would be enough to halt the human-caused rise of CO<sub>2</sub> in the atmosphere.



**“One Health” to increase human, animal and environmental health.** Sustainable agricultural practices in line with EbA avoid agrochemicals due to their harmful effects on ecosystems (such as insects) and human health. They can affect several parts of the human body, leading to reduced labour productivity and even millions of cases of deadly pesticide poisonings. Public health costs of pesticide use in the United States amount to 1.1 billion USD per year. The importance of a more inclusive “One Health” perspective on human, environmental and animal health has recently been highlighted by the Covid-19 pandemic, which revealed the close connections between land use change, wildlife, and infectious diseases. More than two-thirds of known human infectious diseases originated in animals, mostly transmitted to humans from wildlife or livestock. Human encroachment into wildlife habitats through the extension of agricultural lands increases the risk of infection. Conservation of forest areas and natural production systems with wide field margins or buffer areas can reduce this risk by allowing spaces for wild animals to shelter.

## EBA IN THE AGRICULTURAL PRACTICES OF VIETNAM

Climate change is complicating agricultural productivity in northern Vietnam, leading to higher average temperatures, and a less rainfall. Warmer temperatures speed up the reproduction of pests and the spread of diseases, thereby threatening harvests for small-scale farmers, who are predominant in the country. To combat pests and diseases and to protect yields, many farmers rely on expensive synthetic inputs. This added cost has lowered profit margins to such an extent that agriculture often no longer provides enough income to ensure a decent livelihood for farming families. Pesticide use also negatively affects human and ecosystem health in the region.

The villages of Xuân An and Ngọc Sơn in Vietnam's northeastern Bắc Giang Province decided to tackle these challenges with a holistic set of agroecological practices. In addition to specific measures to make agriculture more profitable and sustainable, the intervention included surveys, awareness raising, training and the integration of pesticide risk reduction into strategic plans. A main focus was to make rice fields a suitable habitat for fish and other aquatic animal species, e.g. by widening the distances between plants and creating furrows.

### This led to:

- an increase in fish, ducks, and other natural enemies of rice pests by 35%, leading to **very efficient pest control** that allowed producers to cut pesticide use by up to 100% in rice-duck-fish plots.
- a 75% reduction in fertilizer use, as the animal droppings serve as natural fertilizer when mixed with composted residues and organic waste.
- **Diversified livelihoods** and diets due to more fishing and duck hunting.
- 3 times higher revenues obtained from rice-duck-fish plots compared to rice-only plots.

Home gardens with local varieties of vegetables support diversification and thus help households adapt to climatic shocks and ensure a well-balanced diet for local families. Organically produced vegetables (fertilized with just compost) provide income, especially for women who are traditionally responsible for home gardens. They can sell their vegetables to organic restaurants in nearby towns and share their experiences in the newly established Women's Clubs.



A holistic set of agroecological practices can make agriculture more resilient to climate change. © WorldFish / flickr



Rice fields can be made into a suitable habitat for fish and provide additional income. © Ilocos Norte / flickr





# Where to find more information

## Publications

- Ecosystem-based adaptation in the agriculture sector – A nature-based solution (NbS) for building the resilience of the food and agriculture sector to climate change, [FAO](#) (2020) – provides an overview of EbA benefits in agriculture in different ecosystems.
- The true cost of consumption: The EU's land footprint, [Friends of the Earth Europe](#) (2016) – reveals the what food consumption really costs in Europe.
- Special report on Climate Change and Land, [IPCC](#) (2019) – provides detailed scientific information on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.
- Poster on the principles of Agroecology, [CIDSE](#) – shows the three facets of agroecology, plus principles.
- The Contribution of Agroecological Approaches to Realizing Climate-Resilient Agriculture, [FAO](#) (2019) – analyses the contribution of agroecology regarding climate resilience.
- Approaches to sustainable agriculture – Exploring the pathways towards the future of farming, [IUCN](#) (2020) – examines sustainable options for food production.
- The Economics of Ecosystems and Biodiversity ([TEEB](#)), [UNEP](#) (2018) – measures the economic effects of agriculture on ecosystems and biodiversity.

## Initiatives and networks

- [AgroEcology Fund](#) is a multi-donor fund supporting agroecological practices and policies.
- [Agroecology Now!](#) is a research, action and communications project convened by the Centre for Agroecology, Water and Resilience that focuses on understanding and supporting the societal transformations necessary to enable agroecology as a model for sustainable and just food systems.
- [ELD Initiative](#) – The Economics of Land Degradation (ELD) Initiative is a global initiative established in 2011 to increase and strengthen awareness of the economic dimension of land and sustainable land management.
- [IFOAM – Organics International](#) is a membership-based organization working to bring true sustainability to agriculture across the globe.
- [The Global Alliance for the Future of Food](#) is a strategic alliance of philanthropic foundations working together to transform food systems.
- [True Price](#) is a social enterprise with the mission to realize sustainable products that are affordable to all by enabling consumers to see and voluntarily pay the true price of products they buy.

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