→ 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.

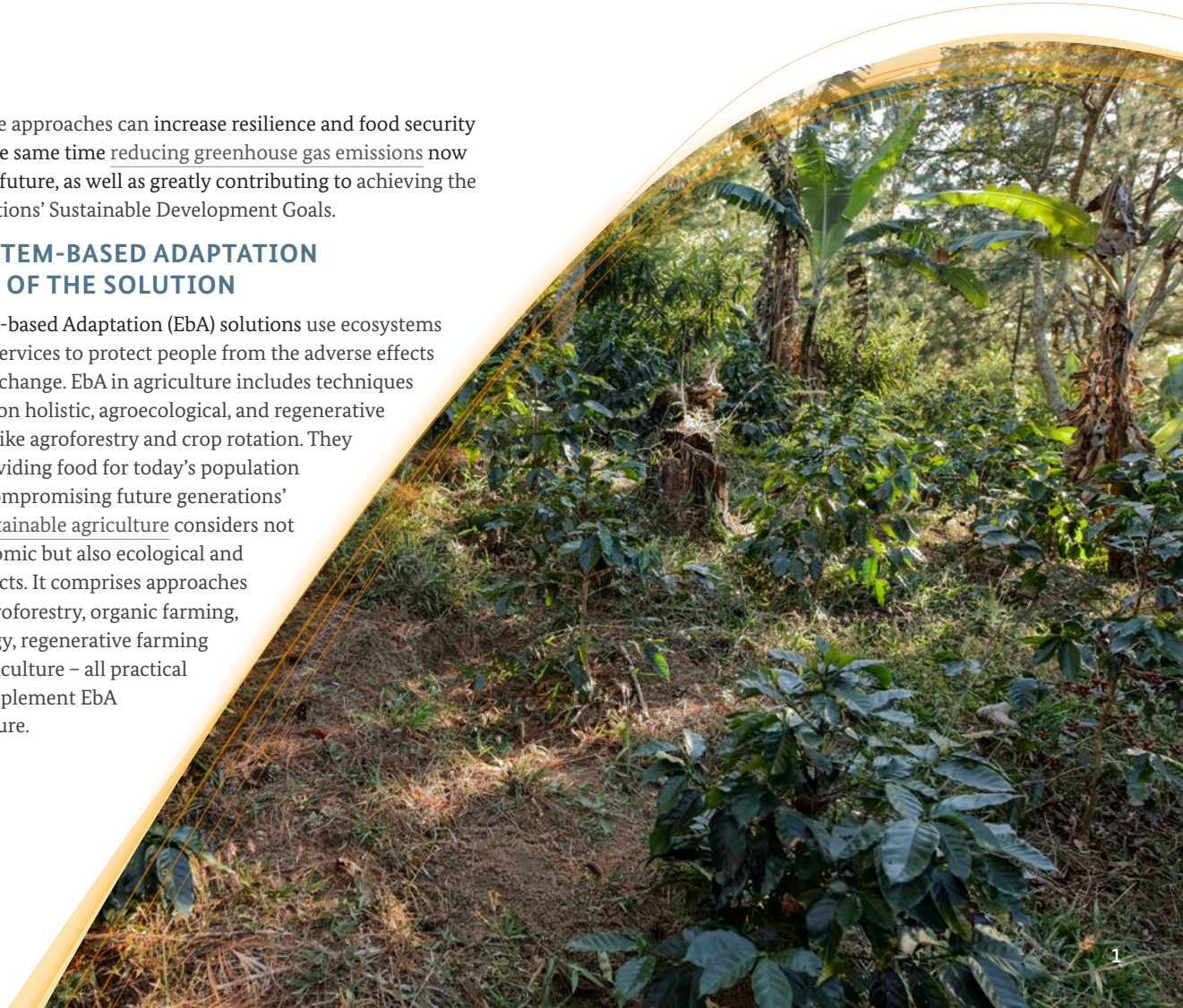
What can we do to reverse this trend? Structural change is needed to safeguard the natural resource base and the biodiversity we all depend on. *Sustainable agriculture* is at the heart of the solution, offering an alternative to industrial agriculture.

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

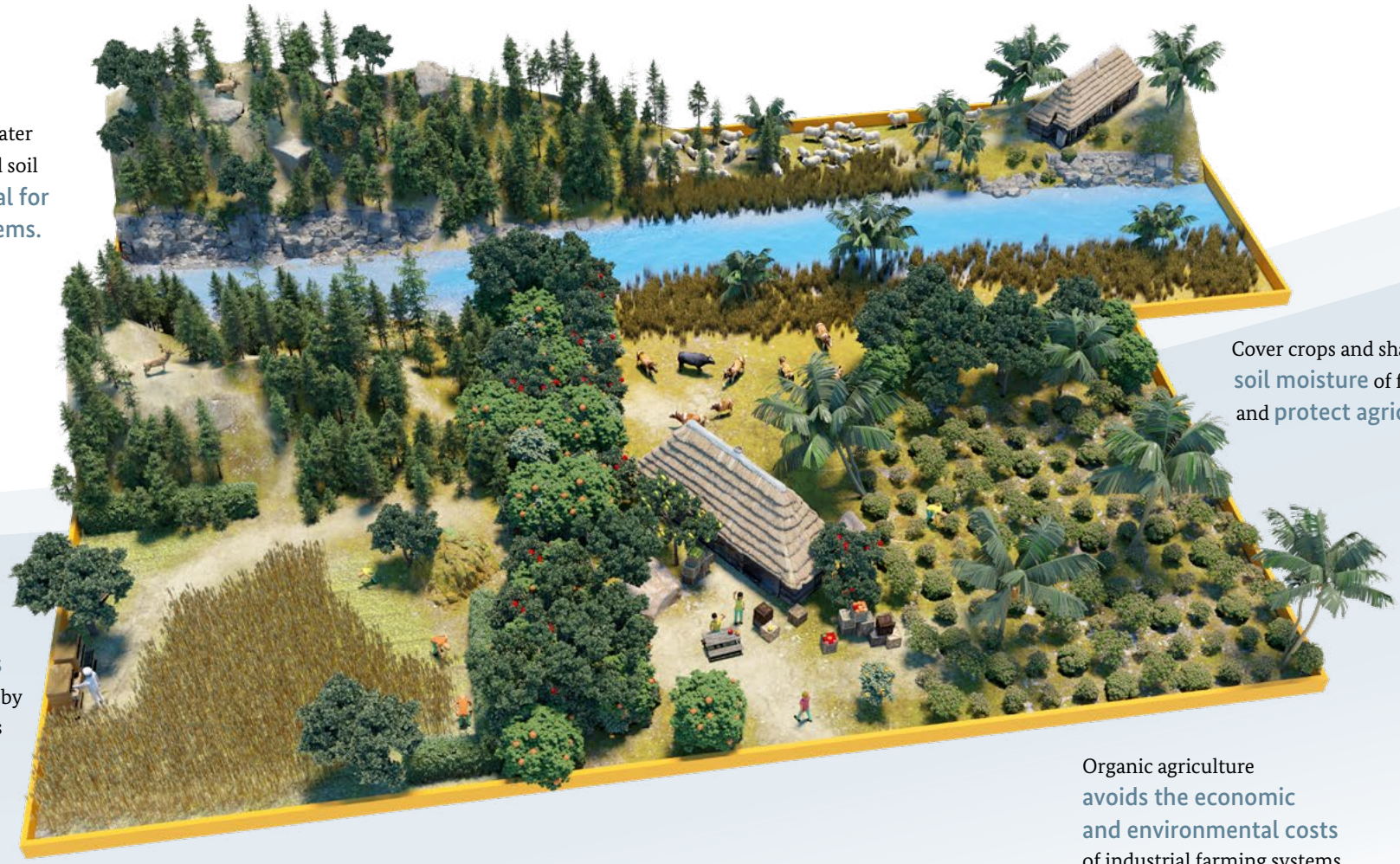
Ecosystem-based Adaptation (EbA) solutions use ecosystems and their services to protect people from the adverse effects of climate change. EbA in agriculture includes techniques that build on holistic, agroecological, and regenerative processes like agroforestry and crop rotation. They aim at providing 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.

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



What are the benefits of EbA in agriculture?

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



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

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

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 faming 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.

CO_2

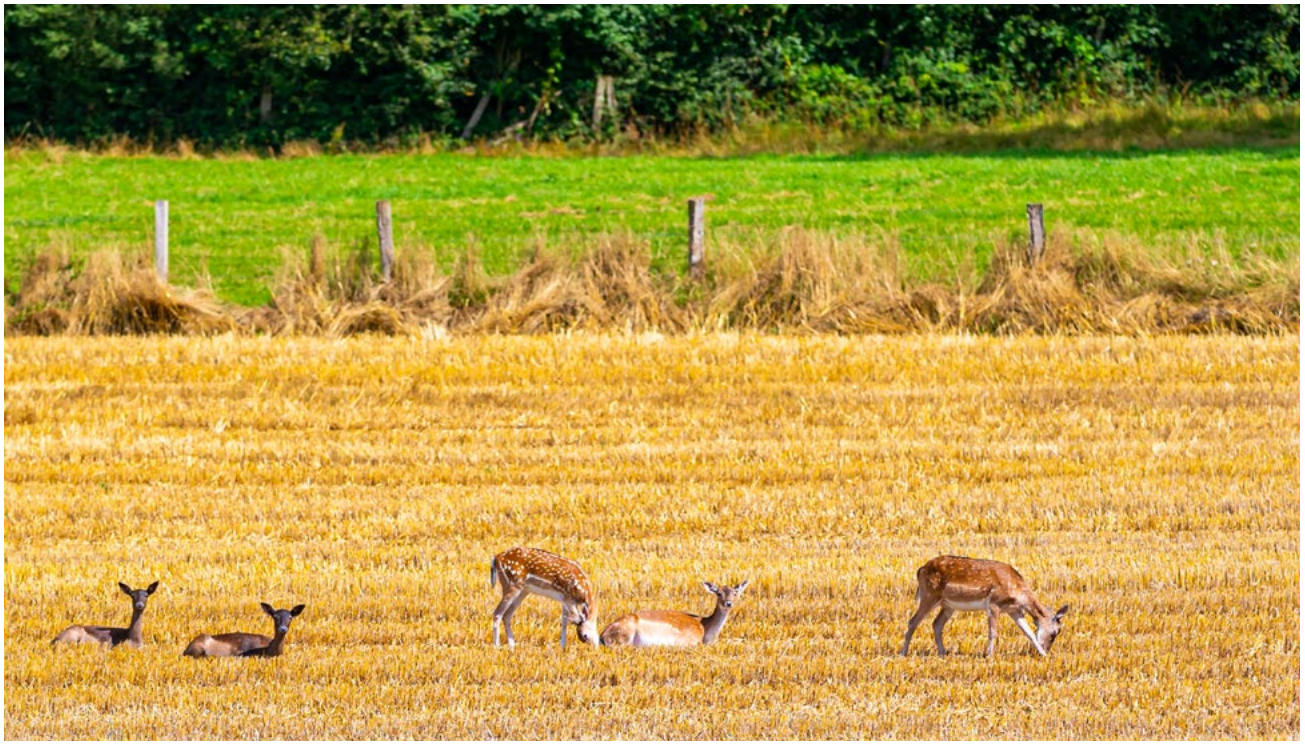
remove up to

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_2 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

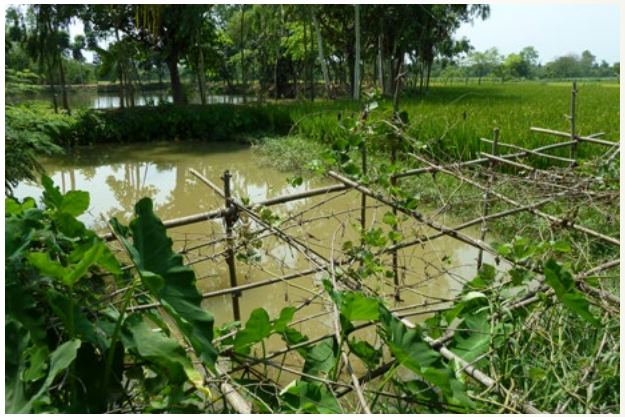
Climate change is complicating agricultural productivity in northern Vietnam, leading to higher average temperatures, and a less rainfall. Warmer temperatures speed up the reproduction of pests and the spread of diseases, thereby threatening harvests for small-scale farmers, who are predominant in the 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.

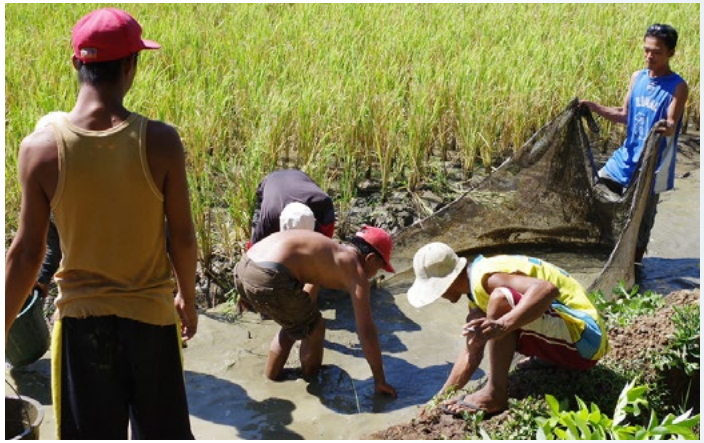
This led to:

- → 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.

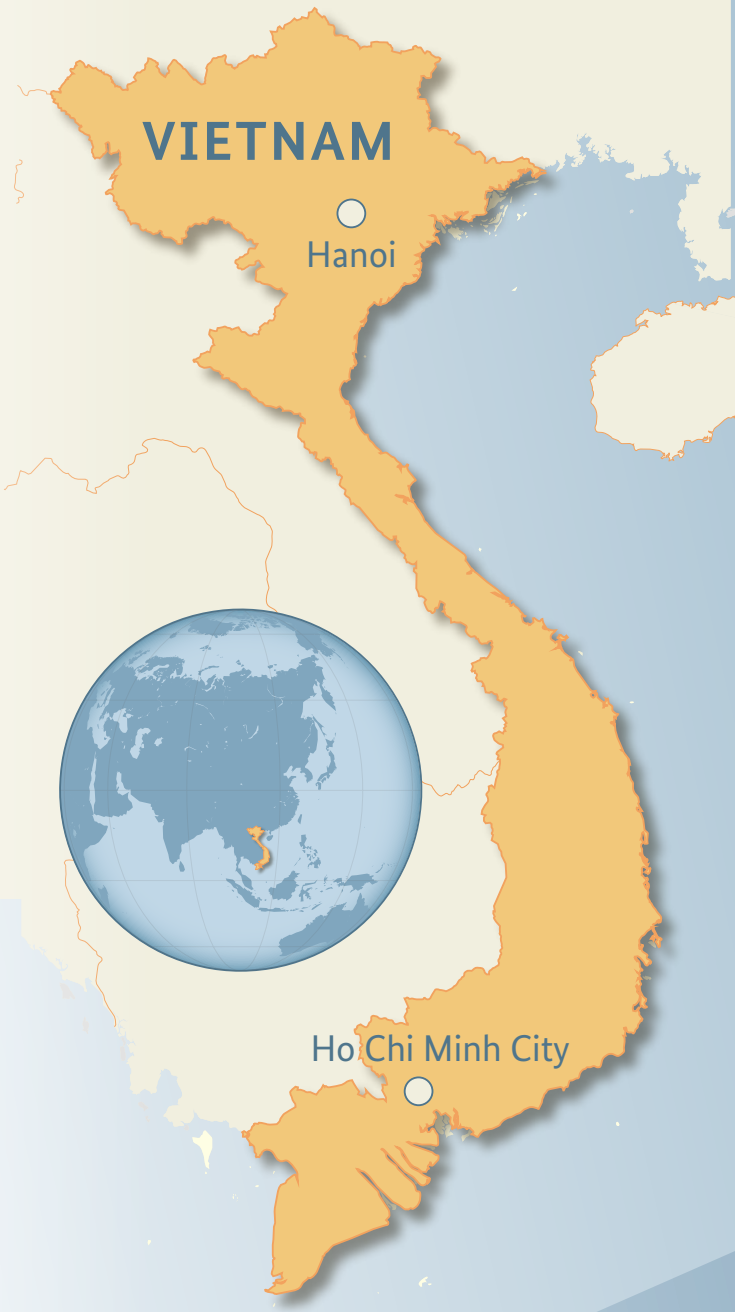
Home gardens with local varieties of vegetables support diversification and thus help households adapt to climatic shocks and ensure a well-balanced diet for local families. Organically produced vegetables (fertilized with just compost) provide income, especially for women who are traditionally responsible 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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