

Transforming Food Systems through True Cost Accounting: Insights and Impact from the EUPI TEEBAgriFood Project 2019 – 2023



Human Capital



Social Capital



Produced Capital



Natural Capital





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Between 2019 and 2023, UNEP implemented an EU -funded project designed to make the economic case for food systems transformation in both the public and private sector. The initiative promoted the adoption of policy scenarios that address the triple planetary crisis – nature loss, climate change and pollution. The project, titled "TEEBAgriFood" (The Economics of Ecosystems and Biodiversity for Agriculture and Food), emphasized the often-overlooked economic contributions that nature provides to economies. This initiative builds upon the UNEP TEEB initiative, which was launched in 2007 during the G8+5 Potsdam Meeting of Environment Ministers. TEEB's mission has been to recognize, demonstrate, and integrate the value of nature and biodiversity into decision-making processes. In 2018 UNEP launched TEEB for Agriculture and Food ("TEEBAgriFood") with a focus on food systems transformation and which considers the entire eco-agri-food systems complex, i.e. the interrelations between the economy, society, the environment and human health and skills. The report of the Scientific Group for the UN Food Systems Summit (UNFSS) makes the case for the inclusion of True Value Accounting [1] ; TEEBAgriFood applies True Value Accounting to analyze and transform food systems globally. The project, funded with EUR 8.5 million under the EU Partnership Instrument, included seven countries: Brazil, China, India, Indonesia, Malaysia, Mexico, and Thailand.

CONTEXT

While agriculture and food production are essential for survival, they significantly impact biodiversity and ecosystem services, contributing to **the triple planetary crisis**:

- **Biodiversity loss:** Agriculture causes 60 per cent of terrestrial biodiversity loss, affecting species and ecosystems both directly and indirectly [2]
- **Climate change:** Food systems account for about one third of global greenhouse gas emissions [3]
- **Soil and water resources:** Food systems are responsible for 33 per cent of soil degradation and 72 per cent of global freshwater withdrawals [4], which strains aquatic ecosystems.

TEEBAgriFood features heavily in the 2023 and 2024 FAO flagship State of Food and Agriculture (SOFA) reports, and also has contributed to UN Food System Summit (UNFSS) national pathways discussions

These environmental pressures threaten food security, economic livelihoods, and social stability. [5] Declining biodiversity destabilizes food production, leading to unpredictable yields, increased harvest losses [6], and adverse impacts on jobs and incomes. Women, who prepare and purchase 90 per cent of food, are disproportionately affected, with 150 million more women than men globally experiencing hunger - often "eating the last and the least" [7].

1 [https://www.unfoodsystemshub.org/food-systems-coalitions/true-value-of-food-initiative-\(tvfi\)/en](https://www.unfoodsystemshub.org/food-systems-coalitions/true-value-of-food-initiative-(tvfi)/en) <https://doi.org/10.5281/zenodo.3831673>

2 <https://www.fao.org/statistics/highlights-archive/highlights-detail/greenhouse-gas-emissions-from-agrifood-systems.-global-regional-and-country-trends--2000-2022/en>

3 *ibid.*

4 https://www.unwater.org/sites/default/files/2023-08/UN-Water_SDG6_SynthesisReport_2023.pdf

5 <https://iopscience.iop.org/article/10.1088/1748-9326/ab4449>

6 <https://www.nature.com/articles/s41586-019-1316-y>

7 <https://www.care.org/wp-content/uploads/2022/08/Final-Version-Food-Security-and-Gender-Equality.pdf>

The **2022 UN Report on Food Security and Nutrition** highlights that this disparity is most severe in the Global South. In response to the worldwide deterioration of ecosystems occurring at unprecedented rates, the global community adopted the **Kunming-Montreal Global Biodiversity Framework (GBF)**.



A farmer at the MARDI demonstration plot prepares coconut husk for vegetable cultivation. This sustainable practice improves water retention, reduces soil depletion, & supports efficient, high-yield farming in the region

Goal B of the GBF focuses on managing biodiversity sustainably, valuing nature's contributions, and restoring ecosystem services by 2050. Though the TEEBAgriFood project predates the GBF, its emphasis on pro-nature policy scenarios supports Goal B.

"The TEEB and TEEBAgriFood approaches are quite central to what we're trying to do here at COP15, notably the Goal B of the Global Biodiversity Framework. We see the value of TEEB in providing a common and streamlined approach, that allows both business and governments to measure and value the environmental, social health and economic costs and possible benefits, and then feed this knowledge into better decision making."

Ms. Astrid Schomaker, Former Director for Green Diplomacy and Multilateralism, Directorate General for the Environment, the European Commission; current Executive Secretary of the CBD

The project also addressed climate and pollution by evaluating changes in greenhouse gas emissions and environmental impacts like pesticide poisoning and particulate pollution (PM2.5). By integrating economic and ecological evaluations, TEEBAgriFood demonstrated that food system transformation can align the interests of people and the planet through informed economic decision-making.

What Was the Approach Adopted?

The TEEBAgriFood approach entails co-developing with key stakeholders transformative yet practical policy scenarios. These scenarios are then evaluated against Business-as-Usual (BAU) to compare their net economic and ecological impacts. The results are then shared and mainstreamed across governments, agribusinesses, civil society groups, and academic institutions.

"TEEB for Agriculture and Food recognizes the diversity of the topic of food and recognizes that it is not just about quantities per hectare, but also about the quality of the food, about the extent of employment, about the impact on the environment, soil, climate, water usage, and on society, as the creation and use of human capital that is knowledge and skills, social capital that is the relationship with the village or the community or in the country within which it operates, and of course natural capital which is the essence of plant growth."

Mr. Pavan Sukhdev, Founder & CEO, GIST; ex-President, WWF-International; UNEP Goodwill Ambassador

In October 2018, UNEP introduced the **TEEBAgriFood Evaluation Framework** (figure 1), which won the Future Policy Vision Award from the World Future Council in partnership with FAO and IFOAM–Organics International. The framework emphasizes a comprehensive assessment of food systems, capturing the often-invisible elements like ecosystem services and non-market contributions. It also incorporates multiple forms of capital:

- **Natural Capital:** Ecosystem services that sustain agriculture
- **Human Capital:** Skills, knowledge, and health
- **Produced Capital:** Tools, technology, and financial resources
- **Social Capital:** Governance systems and networks enabling sustainable management

By applying this holistic evaluation across entire value chains, the framework aligns with the EU's **Farm to Fork** policy. Its analytical models are outlined in the **TEEBAgriFood Modeling Guide for Policymakers**.

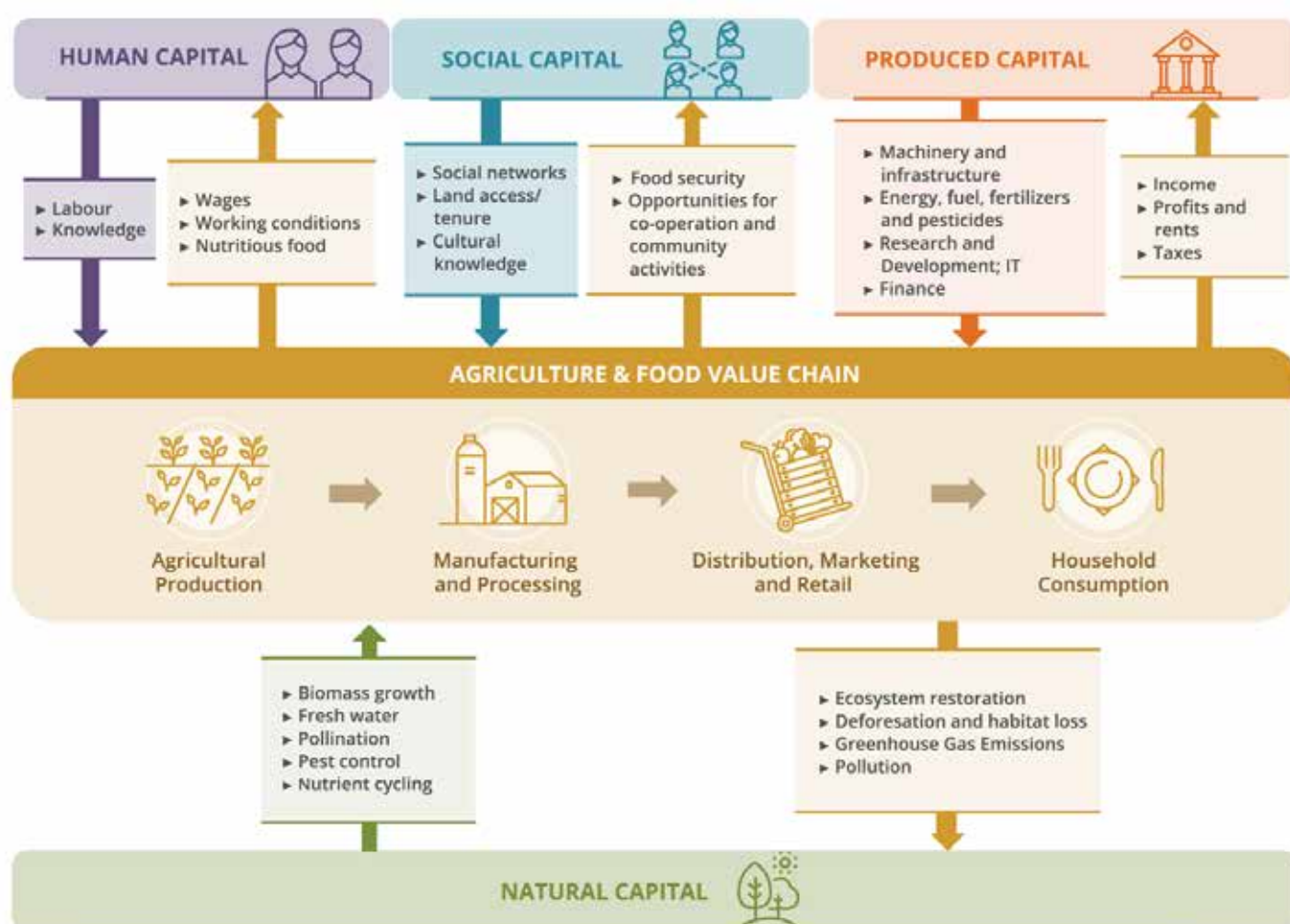


Figure 1 The full TEEBAgriFood Framework

The Framework was applied to one or more ‘**policy scenarios**’ and compared to Business-as-Usual (BAU). These policy scenarios were selected in consultation with stakeholders – Ministries, agribusinesses, civil society groups (including those representing farmers). An example of a policy scenario was upscaling organic production in North-East Thailand under an expansion of the ‘One Million Rai’ initiative. The project engaged both public and private sector actors.

On the latter, TEEBAgriFood Operational Guidelines for Business were developed by the Capitals Coalition [8] and agribusinesses across the seven countries in scope were assisted in applying the guidelines to determine their impacts and dependencies on nature. The following sections provide detailed country-specific insights on policy scenarios and outcomes for the public sector, followed by a summary of private sector contributions.

8 <https://capitalscoalition.org/publication/teebagrifood-operational-guidelines-for-business/>



TEEBAgriFood in Brazil

In Brazil, TEEBAgriFood's advocacy has led to significant policy advancements, including the establishment of the National Programme for Urban and Peri-urban Agriculture (decree 11.700/23), a National Strategy for Food and Nutritional Security in Cities (decree 11.822/23), and a National Law on Urban and Periurban Agriculture (UPA) (14.935/24), marking a substantial reinforcement of the policy framework. The federal government will allocate funding and implement the program in 56 cities nationwide, promoting sustainable urban farming practices that mitigate climate extreme events, support food security, and improve air and water quality.



TEEBAgriFood in Indonesia

The TEEBAgriFood project, led by BAPPENAS (Indonesia's Ministry of National Development Planning), explored agroforestry as a sustainable alternative to monoculture production in the cocoa and coffee sectors. By assessing the economic, social, and environmental benefits of agroforestry, the project highlighted its potential to address deforestation while aligning with Indonesia's development goals, including the food systems approach mandated by Law 22/2019.



TEEBAgriFood in India

The project was designed to have long-lasting impacts beyond its closure in 2023. For instance, TEEB has been included in the syllabus of a new under-graduate programme on Natural Farming by the Indian Council of Agricultural Research, being offered in 55 Agriculture Universities.

Country Scenarios and Impact

"We need to change the way we view cities. Urban environments cannot be seen solely as consumers of food and as responsible for the overexploitation of the environment. Urban environments can also become food producers and contribute significantly to reducing hunger in our country."

Kelliane Fuscaldi, Urban and Periurban Agriculture Coordinator at the Ministry of Social Development and Fight Against Hunger

Brazil

Brazil, home to approximately 203 million people, occupies nearly half of South America and is one of the most biodiverse countries in the world. The country harbors diverse ecosystems from the Amazon rainforest to the Cerrado savanna and is estimated to be home to between 10-15 per cent of all documented species. The varied climate and geography have fostered the evolution of numerous plant and animal species, alongside traditional crops such as cassava and beans, and indigenous breeds of livestock. This agrobiodiversity not only supports ecosystem resilience but also underpins the foundation of food security and nutrition for future generation [9]. However, Brazil faces significant challenges. Rapid deforestation and land conversion for agriculture are the primary drivers of biodiversity loss. These issues are exacerbated by factors such as monoculture farming, heavy agrochemical use, land grabbing, illegal logging, large-scale infrastructure projects, and frequent fires. Together, they erode genetic diversity within agricultural systems [10], reduce the adaptability of crops and livestock, and displace indigenous and local communities [11]. This environmental degradation weakens ecosystem resilience and diminishes the services vital for sustainable agriculture and food production.

⁹ https://www.ipes-food.org/_img/upload/files/UniformityToDiversity_FULL.pdf

¹⁰ <https://doi.org/10.1073/pnas.1313490111>

¹¹ *ibid.*

To address these challenges, the TEEBAgriFood Brazil project implemented two key workstreams:

1. Scaling urban and peri-urban agriculture (UPA)

This workstream focused on promoting urban, and peri-urban agriculture (UPA) as a sustainable solution to strengthen food systems and enhance biodiversity, especially in densely populated areas. The initial efforts centered on the São Paulo metropolitan region, later expanding to the federal level once the benefits of sustainable UPA were documented at landscape level.

To this end:

- UNEP collaborated with four ministries: Environment and Climate Change, Social Development and Combat Hunger, Work and Employment, and Rural Development.
- A Steering and Technical Committee was established together with the research partner, the Center of Sustainability of Fundação Getúlio Vargas, with 60 stakeholders representing civil society, research groups, and all levels of government. Over 50 per cent of participants were women, ensuring gender inclusivity.
- A UPA Guide for municipal managers was developed, offering tools and strategies to scale up UPA policies and initiatives.

"The TEEBAgriFood framework qualified the National Urban Agriculture Program by being able to relate social dimensions to human dimensions, economic dimensions, and environmental dimensions."

Kelliane Fuscaldi, Urban and Periurban Agriculture Coordinator at the Ministry of Social Development and Fight Against Hunger

The project's findings highlight UPA's potential as a nature-based solution to tackle food insecurity, improve urban climate resilience, and provide economic opportunities, particularly for women, who often lead these initiatives. As shown in future scenarios, UPA has the potential to deliver significant environmental benefits – among others:

- It can reduce urban temperatures by up to 0.2°C
- It can improve water infiltration to the equivalent of three flood control pools, each valued at US\$30 million
- It can transform 2 million tons of organic urban waste into fertilizers, generating savings of US\$70 million



Aerial view of an organic urban farm in the heart of São Paulo. Urban agriculture plays a vital role in enhancing food security, promoting sustainability, and creating green spaces within the city

TEEBAgriFood's advocacy efforts have led to significant policy advancements, including the establishment of the National Programme for Urban and Peri-urban Agriculture (decree 11.700/23), a National Strategy for Food and Nutritional Security in Cities (decree 11.822/23), and a UPA National Law (14.935/24), marking a substantial reinforcement of the policy framework. The federal government will allocate funding, and implement the program in 56 cities nationwide, promoting sustainable urban farming practices that mitigate urban heat, support food security, and improve air and water quality. TEEBAgriFood's influence on Brazil's food system transformation demonstrates how nature-based solutions in urban areas can effectively address environmental, and social challenges, advancing both food security and resilience across urban landscapes.



São Paulo, home to 11.45 million people, is the largest city in the Southern Hemisphere. Its rapid urbanization presents both challenges and opportunities for urban and peri-urban agriculture as a strategy for food security, livelihoods, and sustainability

2. ABC+ Plan for low carbon agriculture

The second workstream evaluated the environmental and socioeconomic impacts of Brazil's ABC+ Plan, which aims to restore 30 million hectares of degraded pastures by 2030. The plan focuses on degraded pasture recovery (RPD) as a means to promote sustainable agriculture while mitigating climate impacts.

"In 2022, through the partnership between the Brazilian government and the United Nations Environment Programme, Brazil launched the 'Municipal Agendas for Urban and Peri-Urban Agriculture,' a guide to incorporate agriculture into urban planning processes. This document put Brazil in a unique and pioneering position as the first country to construct, in a participatory manner, a document aimed at guiding municipalities in driving the urban and peri-urban agriculture agenda."

Kelliane Fuscaldi, Urban and Periurban Agriculture Coordinator at the Ministry of Social Development and Fight Against Hunger

The study highlights that:

- Pasture recovery can significantly boost beef and dairy productivity, reduce greenhouse gas emissions, and increase soil carbon sequestration, with the potential to decrease emissions intensity in livestock production by up to 14.60 per cent for dairy and 28.78 per cent for beef.
- Additionally, this effort could avoid the conversion of approximately 6.2 to 7.2 million hectares of natural vegetation to agriculture with associated benefits including improved biodiversity outcomes, and higher net provisioning of ecosystem services.
- Economically, the project estimates an increase in GDP of up to R\$ 202.4 billion (US\$38.92 billion) if integrated crop-livestock systems are adopted alongside pasture recovery practices, which would also support rural income growth and food price reductions benefiting low-income households.

However, the transition toward low-carbon, sustainable agriculture will require coordinated support, including improved access to rural credit, technical training for farmers, and governance measures to ensure equitable outcomes across rural communities.



A weekly market in the center of São Paulo, where small-scale and urban farmers can connect with consumers. Strengthening access to local markets is essential for promoting sustainable urban and peri-urban agriculture in Brazil

China

As a mega-diverse country and major food producer, China faces severe soil degradation, water pollution, and biodiversity loss due to intensive agricultural practices. Soil erosion, high pesticide use, and overgrazing have impacted ecosystem health. Conservation efforts are underway, including reforestation and incentives to improve grassland conditions, but food production remains a heavy strain on biodiversity.

The TEEBAgriFood project in China began with an inception workshop in Beijing (2019), engaging a wide range of stakeholders, including ministries, researchers, and local governments.

This forum laid the groundwork for understanding critical policy interventions, exploring themes like eco-compensation, organic agriculture, and green food branding.

TEEBAgriFood China focused on two different workstreams. Following a stakeholder consultation process involving national and local authorities, UNEP assessed (1) policy scenarios to [address pollution, fertilization practices, and green branding policies in Tengchong City](#), and (2) in [Heilongjiang Province, black soil restoration and soybean expansion policies](#) in response to climate change and geopolitical challenges.

In Tengchong City, through scenario analysis the project explored the benefits of reducing agrochemical use, implementing mixed planting and breeding practices, and reducing waste through circular approaches. These measures have demonstrated significant savings in environmental and health costs, with non-point source pollution costs projected to decrease by up to 45.5 per cent in optimistic scenarios.

"The G20 Bali Leaders' Declaration calls for an accelerated transformation towards sustainable and resilient agriculture and food systems and supply chains. TEEBAgriFood is a positive step towards building a biodiversity-friendly agriculture and food system, and it also fits well with China's philosophy of harmony between humans and nature [...] (The TEEBAgriFood application) is a concrete practice to implement the Bali Leaders' Declaration and a positive exploration of the transformation of global agri-food systems."

Mr. Huang Runqiu, Minister of Ecology and Environment of China and President of the COP15

The TEEBAgriFood study also highlighted how eco-tourism could contribute to economic growth, nearly matching agricultural income, while reinforcing ecosystem conservation. By supporting China's "Green to Gold" transformation, the project's outcomes inform sustainable policy development, aligning with the China Biodiversity Conservation Strategy and promoting broader ecological civilization efforts. The analysis on soybean expansion in Heilongjiang found that encouraging sustainable farming practices through incentivization and technological advancements is vital to enhance resource efficiency and reduce environmental impact.



© unsplash / Matt Briney

A farmer harvests maize in China

The analysis of the total costs and benefits in Heilongjiang Province provided valuable insights into the trade-offs associated with different soybean expansion scenarios.

Overall, soybean expansion would generate environmental and human health benefits, such as reduced air pollution, water discharge, carbon emissions, and human exposure to agrichemicals. By 2050, the annual cost of air emissions, water pollution, GHG emissions, and health exposure would be US\$5 million, US\$12 million, US\$18 million and US\$100 million less, respectively, under a soybean expansion scenario as compared to prioritisation of rice and maize. The overall economic costs, however, of reduced agricultural income, employment and the cost of government subsidies outweigh these benefits. Nevertheless, soybean expansion remains a priority for the Chinese government, primarily due to national food security concerns and resilience to international price fluctuations, the benefits of which are difficult to quantify. This analysis has shed light on the economic, environmental, and societal factors involved in transitioning to soybean cultivation, enabling policymakers to make evidence-based decisions that align with their goals for sustainable and efficient crop provisioning.

India

India's rich biodiversity and traditional knowledge coexist with intensive agriculture that puts pressure on ecosystems. High livestock density and agrochemical use have degraded soils, fragmented landscapes, and stressed water resources. In response, India has expanded organic farming, increased forest cover, and reformed fertilizer policies to improve soil health. The TEEBAgriFood project in India was co-chaired by the Ministry of Agriculture and Farmers Welfare (MoAFW) and the Ministry of Environment, Forests and Climate Change (MoEFCC). The process began with extensive stakeholder consultations in Uttar Pradesh and Uttarakhand in 2022 to define the scope and align priorities with state and national goals. These discussions informed the scenario setting and scoping reports, which were presented at a national-level consultation in November 2022. The project scope was agreed – making the economic case for agroforestry and organic production. Following recommendations from the PSC, the project was extended to Assam, where unique agroecological conditions and existing initiatives like the Mission Organic Value Chain Development –Northeast Region (MOVCD-NER) and the National Bamboo Mission were integrated into the TEEBAgriFood framework.



TEEBAgriFood studies include a structured gender analysis. The India study used the Appraisal of Women Empowerment (WE) to assess the role of women in decision making and participation in agricultural activities. The study indicates that 43 per cent were involved in decision making on crops to be sown in organic farming as compared to 21 per cent in conventional farming.

Scoping activities were conducted in collaboration with the Central Agroforestry Research Institute (ICAR-CAFRI) and Assam Agricultural University, culminating in a state-level study focusing on organic farming and agroforestry. The project emphasized data-driven analysis, with research partners employing integrated modeling to evaluate changes in natural, social, human, and produced capitals. Draft results from Uttar Pradesh and Uttarakhand were internally reviewed and shared during state-level consultations in August 2023, while similar modeling for Assam was refined to address specific local needs. An overall improvement in livelihoods and empowerment of women is advocated by adoption of climate resilient agriculture, of which organic farming and agroforestry are crucial components. Notable impacts:

- TEEB has been included in the syllabus of a new under-graduate programme on Natural Farming by the Indian Council of Agricultural Research, being offered in 55 Agriculture universities
- Based on the work conducted in the EU-funded project the annual meeting of the All India Network on Organic Farming (AINOF) in 2024 discussed TEEBAgriFood as the core framework for ecosystem services assessment in Organic and Natural Farming Systems [12]
- The TEEB framework was included in the G20 Compendium of best practices in land restoration during India's Presidency in 2023 [13]

Indonesia

Indonesia, whose tropical rainforests are second only to Brazil in biodiversity, faces deforestation and habitat loss, driven by demand for tropical agricultural commodities such as palm, rubber, cocoa, and coffee. While efforts to promote sustainable land management and reforestation are underway, further coordinated action is critical to preserving biodiversity and maintaining ecosystem balance.



Integrating cacao with diverse tree species helps improve soil fertility, enhance biodiversity, and support sustainable livelihoods for smallholder farmers

The TEEBAgriFood project, led by **BAPPENAS** (Indonesia's Ministry of National Development Planning), explored agroforestry as a sustainable alternative to monoculture production in the cocoa and coffee sectors.

"As we embark on the transition to a new administration, BAPPENAS is promoting the TEEBAgriFood approach in agricultural regions (e.g. Medan, Makassar, and Surabaya) to enable our local and sub-national leaders to make transformational changes. Their response has been enthusiastic, because true cost accounting can help these leaders justify long-term planning actions that will bridge future administrations."

Ir. R. Anang Noegroho, National Convener for Food Systems Transformation

12 <https://www.unep.org/events/conference/release-framework-assessment-ecosystem-services-organic-and-natural-farming>

13 https://g20land.org/wp-content/uploads/2023/09/G20_ECSWG-Compendium_of_Best_Practices_on_Restoration_of_Forest_Fire_Affected_Areas.pdf

"This collaboration with UNEP has helped guide Indonesia's transition to evidence-based, holistic policy making for the food and agriculture sector."

Ir. R. Anang Noegroho, National Convener for Food Systems Transformation

By assessing the economic, social, and environmental benefits of agroforestry, the project highlighted its potential to address deforestation while aligning with Indonesia's development goals, including the food systems approach mandated by [Law 22/2019](#).



For years, this 75-year-old Javanese farmer tried to fight off yaki monkeys that raided his cacao farm. In the end, he found peace by dedicating part of his land to them - creating a balance between farming and wildlife conservation through agroforestry

In 2020, UNEP-TEEB conducted a preliminary assessment of the challenges and opportunities in Indonesia's cocoa sector, revealing that cocoa agroforestry could be sustainably intensified to increase yields while delivering significant social and environmental benefits. These findings influenced national policy, with [Executive Order 18/2020](#) incorporating agroforestry goals into Indonesia's [Medium-Term Development Plan \(RPJMN\)](#). Building on this foundation, UNEP facilitated a comprehensive value chain analysis in the cocoa sector, conducted by the Bogor Agricultural University (IPB).

This analysis used integrated biophysical and economic modeling to evaluate the societal benefits of agroforestry compared to monoculture systems, assessing ecosystem services, economic outcomes, and human capital impacts. Recognizing IPB's strong capacity to apply the TEEBAgriFood framework, UNEP expanded the project to include the coffee sector. Field surveys in key coffee-growing regions supported a detailed assessment of agroforestry coffee systems, and UNEP also explored the implications of the EU Deforestation-Free Supply Chain Rule (EUDR) to ensure alignment with international sustainability standards.

The cocoa and coffee sector analyses indicated that while monoculture production offers higher short-term yields, agroforestry provides long-term societal benefits from ecosystem services, especially soil retention (erosion prevention), pollution control (P and K retention), and carbon sequestration. Agroforestry systems can also diversify farmers' incomes, provide habitat for biodiversity, and maintain healthy soil.

Using a SWAT model to compare water and soil attributes of coffee systems found:

- That agroforestry coffee systems could offer 69 per cent to 79 per cent less soil loss and 66 per cent to 92 per cent less sediment yield per hectare than non-agroforestry coffee systems
- Agroforestry systems could store 41 per cent - 111 per cent more carbon

The human capital assessment of cacao production found that although agroforestry systems required more labor, labor productivity measured in IDR/worker-days is higher for agroforestry systems. The assessment estimated that cacao agroforestry with durian production could achieve 38 per cent greater labor productivity than monoculture cacao production (303 IDR/worker-day versus 219 IDR/worker-day, respectively).

IPB facilitated discussions in the study regions on supporting agroforestry through policy incentives, technical training, and financial assistance. Three key policy areas were identified to encourage agroforestry, support for capacity development on agroforestry technical implementation and marketing, certification to comply with the EU Deforestation Free Rule (EUDR), and establishment of a payment for water regulation services program in landscapes where agroforestry could protect downstream water resources.



TEEBAgriFood Indonesia has had concrete policy impacts. For instance, BAPPENAS has acknowledged the contribution of TEEBAgriFood to justify the inclusion (for the first time) of agroforestry goals in the Medium-Term Development Plan

Malaysia

Malaysia has committed to conserving forest cover, but agricultural expansion and intensification continues to undermine ecosystems services. Policies promoting sustainable agriculture and forest conservation are in place, yet invasive species and pesticide use threaten natural ecosystems and biodiversity. **TEEBAgriFood Malaysia assessed the potential impacts of increasing farmers' adoption of the MyGAP (Malaysian Good Agricultural Practices) standard in vegetable production in the Cameron Highlands.**



Organically grown chives and leafy greens on a MARDI research plot in the Cameron Highlands. Inter cropping helps to naturally repel pests and reduces the need for chemical pesticides

The project began with defining the scope: evaluating the costs and benefits of MyGAP adoption under scenarios such as partial and full implementation, prohibition of farming on steep slopes, erosion control and pesticide-free certification.

From the outset, multi-stakeholder engagement was prioritized, involving national policymakers, state government and farming communities.

Key findings suggest that incentivizing the adoption of MyGAP, alongside integrated pest management, could minimize trade-offs between agriculture and ecosystem services and promote sustainability in the region. The research has fostered dialogue among national and Pahang state government agencies positioning sustainable agriculture adaptations as crucial to the future of the Cameron Highlands, with the potential to influence land use practices and improve sustainability in this sensitive ecosystem and touristic, high-value agricultural area.



© UNEP / Anna Hellge

A MARDI researcher conducts an early morning insect survey on a research farm, monitoring pest populations as part of an Integrated Pest Management (IPM) strategy. IPM reduces reliance on chemical pesticides by promoting natural pest control methods

The success of the project in Malaysia is evident in the significant engagement of high-level stakeholders and its continued impact beyond the project's formal conclusion. The Steering Committee was chaired by the Deputy Secretary General of the Ministry of Agriculture and Food Industries (MAFI), and included the Director General of the Malaysia Agricultural Research and Development Institute (MARDI). In December, 2024, 12 months after the official conclusion of the TEEBAgriFood project, MARDI, MAFI and Pahang State authorities independently organized a follow-up workshop in the Cameron Highlands to discuss the implications of the TEEBAgriFood Project results. This meeting, funded entirely by MARDI, brought together key stakeholders, including Pahang State Department of Agriculture, Pahang State Economic Planning Unit and Pahang Land Corporation, underscoring their commitment to advancing the project's objectives.

Mexico

The TEEBAgriFood Mexico project was initiated in February 2019 with a high-level dialogue at the Ministry of Agriculture's Center for the Integration of Biodiversity. This dialogue introduced the TEEB initiative to Mexican government agencies and food systems stakeholders and secured agreement on study areas, aligning the project with Mexico's National Development Plan. A Project Steering Committee comprising representatives from 17 institutions guided the initiative, identifying two food sectors for assessment: maize and milpa systems for an IKI-funded TEEBAgriFood application, and **agroforestry coffee** for the EUPI-funded application. Both projects were guided by this high-level steering committee co-chaired by Mexico's agriculture and environment ministries (SADER and SEMARNAT), with results presented to policymakers, including recommendations to enhance agrobiodiversity protection, support smallholders, and improve the resilience of rural communities.



A coffee producer processes specialty coffee in Mexico, where high-quality beans command a premium price

INECOL (National Ecology Institute) conducted the coffee value chain analysis, evaluating risks and threats to the coffee sector in Mexico from climate change, disease, and global competition. INECOL analyzed trends among coffee growers towards intensification and full-sun production and modeled their potential impacts through 2040. Fieldwork collected socio-economic and biophysical data to model scenarios for coffee production, comparing commodity-grade intensification with sustainable specialty coffee. This included evaluating the impacts of agroforestry systems on farmer livelihoods, biodiversity, and climate resilience. INECOL also assessed land use trends in coffee-growing areas, combining this data with climate change projections to model expected changes in ecosystem service provision over the next 20 years.



Coffee cherries ripen on a shade-grown coffee farm in Mexico. Cultivating specialty coffee within agroforestry systems enhances biodiversity, improves soil health, and can support sustainable livelihoods for farmers

The findings revealed that over the past 15 years, unsustainable practices - such as shade pruning and the conversion of coffee plantations to other land uses - have already caused a 4 per cent reduction in sediment retention, increased surface water flows, and greater nutrient transport (e.g., phosphorus) to downstream waterways. Climate change is expected to exacerbate these impacts. By 2045:

- Rapid water flows could increase by 20 per cent under RCP 4.5 and 21 per cent under RCP 8.5.
- The capacity of vegetation to retain sediments could decrease by 33 per cent under RCP 4.5 and 41 per cent under RCP 8.5.
- Carbon storage could decline by 5 per cent under a Business-As-Usual (BAU) scenario.

These projections underscore the severe consequences of a "do nothing" approach to agricultural land use management. They highlight the urgent need to protect and restore agroforestry coffee systems as a strategy to mitigate these impacts, preserve ecosystem services, and enhance climate resilience.

The analysis provided evidence to support policy decisions that promote agroforestry-based coffee production, especially in light of climate change impacts and international competition. The evaluation determined that adapting to climate change and surviving in an increasingly competitive global coffee market depends on strengthening the capacity of growers to manage shade, adopt innovations to augment production, and cooperate with each other to access value-added markets. Both studies catalyzed public policy dialogue around sustainable agriculture. UNEP contracted an environmental policy specialist consultant to facilitate discussions with high-level officials in SADER, SEMARNAT, the Mexican legislature and senate.

Notably, the maize sector findings were synthesized into a policy brief that was presented to the Cámara de Diputados, Comisión de Desarrollo y Conservación Rural, Agrícola y Autosuficiencia Alimentaria. The coffee sector findings were synthesized into nine policy recommendations in order to spark national discussions among government officials. UNEP hosted a public-private dialogue between coffee growers, sustainable coffee certifiers, and coffee processors to discuss threats and opportunities for supporting sustainable coffee practices.



UNEP Ecosystems Director Susan Gardner with Legislative Committee president Maria de Jesus Aguirre and TEEB staff member Jacob Salcone after presenting to the Mexican Legislative Committee on Rural Development and Conservation, Agriculture and Food Security, December 2023

Thailand

Thailand's biodiversity is threatened by agricultural expansion, with significant forest cover lost to farming. Intensive irrigation for rice and heavy use of fertilizers have degraded soil and natural water systems. Traditional crop varieties face genetic erosion, while environmental pressures continue to challenge agricultural sustainability. In Thailand, the **TEEBAgriFood project evaluated the impacts of transitioning from conventional to sustainable rice practices in the Central and Northeast regions.**

The project was formally endorsed by the Office of Natural Resources and Environmental Policy and Planning (ONEP) in 2018. It began with an inception workshop to finalize study options and train stakeholders on scenario development and modeling. By focusing on sustainable rice production under the SRP Standard, the project sought to evaluate the economic case for sustainable practices and support spatial planning for rice production at the landscape level.

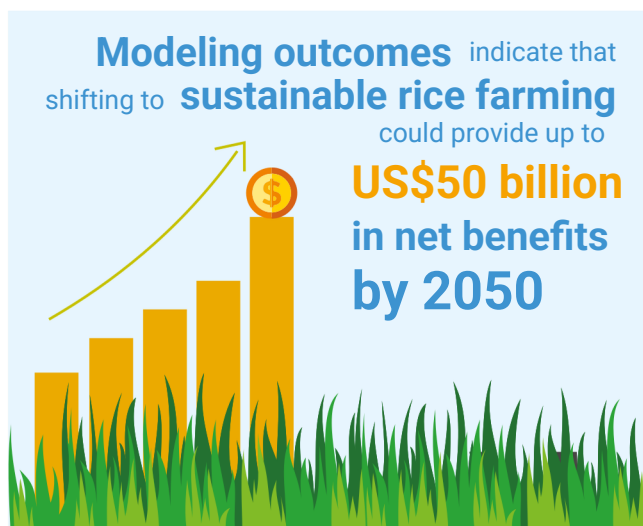


A farmer in Thailand inspects her rice field, where she practices Alternate Wetting and Drying (AWD). This water-efficient technique reduces methane emissions and conserves water.

The project involved a series of key activities designed to ensure comprehensive and impactful outcomes:

- Stakeholders from public and private sector, including farmers, local officials, and rice industry representatives, participated in consultations to refine the project's scope and methodology, aligning early efforts with Thailand's 20-year National Strategy and agricultural policies.
- In partnership with Khon Kaen University (KKU), the project team developed a methodological framework, conducting detailed biophysical modeling and value chain assessments to evaluate the SRP framework's effectiveness in enhancing biodiversity, ecosystem services, and farmer livelihoods while mitigating environmental degradation.
- Policy mapping exercises identified opportunities to integrate environmental performance indicators into agricultural policies, with scenario modeling assessing the comparative costs and benefits of SRP-compliant practices versus conventional methods.
- Extensive fieldwork was conducted to collect data from farmers and stakeholders, ensuring that the biophysical analysis accurately reflected the realities of rice production across Thailand's diverse landscapes.
- Regular stakeholder engagement workshops, including the National Workshop in November 2023 attended by 145 participants from 60 institutions, provided a platform for presenting draft results, fostering knowledge exchange, and building momentum for the widespread adoption of sustainable practices.

Focusing on sustainable methods such as improved water and nutrient management, integrated pest control, and reduced post-harvest burning, the study demonstrated that widespread adoption of these practices could generate significant benefits



primarily by enhancing farmer income, reducing public health costs, and lowering greenhouse gas emissions through improved soil carbon retention and the elimination of stubble burning. Additionally, sustainable practices promoted greater biodiversity and water efficiency, while reduced pesticide use led to improved community health. The TEEBAgriFood study's findings align with Thailand's Bio-Circular Green Economy model, emphasizing sustainable agricultural development that integrates ecological benefits into economic decisions.

TEEBAgriFood for Business

Agri-businesses are often not aware of their impacts and dependencies on nature, and/or do not have the capacity to measure these impacts and dependencies, and/or do not have the tools to act. The project aimed to address all three elements and in so doing develop the enabling environment for farmers and agri-businesses acted as change agents for pro-nature solutions rather than change blockers.

"All businesses depend on nature. The food and agriculture sectors have underinvested and under leveraged nature-based solutions. Business leadership is needed for deep rapid and systematic transformation of the food system so that we can both have healthy people and a healthy planet."

Mr. ZHOU Weidong, Director of China Office, World Business Council for Sustainable Development

The TEEBAgriFood Private Sector component was led by the Capitals Coalition [14], focused on integrating a capitals assessment into agrifood business decision-making, i.e. apply the same TEEBAgriFood Framework that was used to make the case for public sector policy reform but apply this to the private sector. Through the project, the Capitals Coalition and UNEP developed, launched, and applied the **TEEBAgriFood Operational Guidelines for Business** [15], informed by pilot applications and stakeholder feedback across seven countries. During the project, training sessions reached over 700 participants, including 374 business representatives, and guided 32 businesses through capitals assessment pilots.

"The TEEBAgriFood framework is comprehensive and can transform businesses to thrive. The holistic approach helped us to prioritise high impact areas, strengthen stakeholder confidence, stay motivated and committed for a larger cause"

Sarang Vaidya, Co-founder, Go4Fresh, Mumbai, India

The pilot applications incorporated a strong gender-responsive approach. For instance, Aires de Campo in Mexico actively promotes gender equality by employing a high proportion of women in managerial roles and prioritizing the hiring of female heads of households. In Thailand, the Biovert case study exemplified this approach by developing climate-smart aquaculture solutions that explicitly incorporated gender considerations.

The Capitals Coalition and UNEP collaborated with local in-country partners: Brazil - the Brazilian Business Council for Sustainable Development (CEBDS); China – GoldenBee; India - Centre for Responsible Business (C4RB); Indonesia – the Indonesia Business Council for Sustainable Development (IBCSO); Malaysia - DHI Malaysia; Mexico – AMEBIN; and Thailand - Scholars of Sustenance (SOS).

¹⁴ <https://capitalscoalition.org/>

¹⁵ <https://teebweb.org/our-work/agrifood/reports/teebagrifood-operational-guidelines-for-business/>

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