Transforming Food and Agricultural Systems in Support of the SDGs: The Key Role of Agroecology

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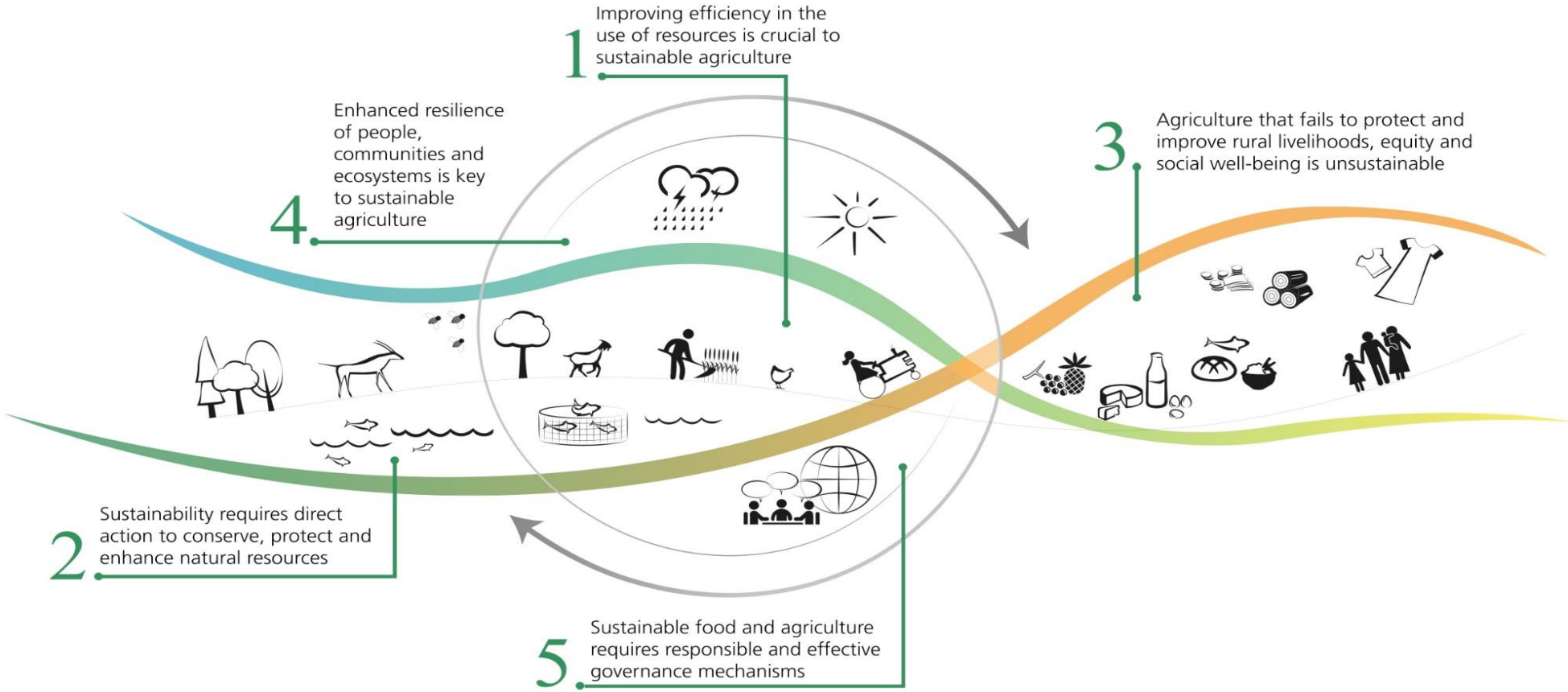
A long history of agricultural ‘revolutions’

- Neolitic: 10,000 years
- Middle age (X s.)
- Industrial (XVIII-XIX)
- Green Revolution (1950-70)
- …

Challenges of current agricultural models

- Decreased area of pasture and natural habitats
- Water pollution
- Increased agriculture production costs (costs of inputs dependent on oil prices)
- Increased use of (and resistance to) pesticides and herbicides
- Reduction of pollinators
- Decrease in soil health (fertility, earthworms, biodiversity loss, erosion)
- Increased diseases (cancer, celiac disease)
- Low diversity in food of poor nutritional quality

2014: 5 principles of Sustainable food and agriculture



Agroecology

multiple and evolving definitions

- “The application of ecological science (the science of how nature works) to the study, design and management of sustainable agriculture” (Altieri 1995)
- “The ecology of the food system” (Francis et al., 2003)
- “A science, a social movement and a practice” (Wezel et al., 2009)

→ more than 30 definitions of agroecology

Agroecology: Common points

Despite the diversity of situations observed in the regions, successful initiatives in agroecology share a number of **common points** :

» **Ecosystem based**: boosting efficiency in the use of natural resources (soil, air, sun, and water) through the synergy of components

» **Focus on** the recycling of elements

» Makes a broad use of **agrobiodiversity**

» **Diversification** of production systems and products in space and time.

» **Context-specific:** local solutions

Agroecology: main characteristics

1) Emphasizes the **interconnectivity** of all agroecosystem components and the complex dynamics of ecological processes that drive productivity, stability and resilience

2) Aims at the holistic approach to **agroecosystems** which are seen as complex systems in which ecological processes occur, e.g. nutrient cycling, predator/prey interactions, competition, symbiosis and successional changes.

3) **Reincorporates diversity** into the agricultural fields (variety mixtures, rotations, polycultures, agroforestry, crop-livestock integration, etc) and surrounding landscapes

4) Is highly **knowledge-intensive,** and is based on techniques that are not delivered top-down, but developed on the basis of farmers' knowledge and experimentation

10 ‘ELEMENTS’ OF AGROECOLOGY

RESPONSIBLE GOVERNANCE

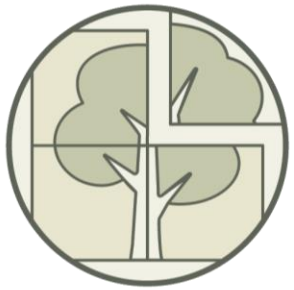
DIVERSITY

SYNERGIES

EFFICIENCY

CIRCULAR AND SOLIDARITY ECONOMY

HUMAN AND SOCIAL VALUES



CO-CREATION AND SHARING OF KNOWLEDGE

RESILIENCE

RECYCLING

CULTURE AND FOOD TRADITIONS

Interactions in AGROECOLOGY

Virtuous Cycles and Ecosystem Services that Underpin Agricultural Production

POLLINATION

Most flowering plants only produce seeds if animal pollinators move pollen from the anthers to the stigmas of their flowers. Pollination as a factor in food production and security has been little understood and appreciated, in part because it has been provided up until now as a "free service" by nature. As pollination services have faced several threats, there is a great interest in understanding key interactions and helping nature provide these pollination services, through greater diversity on farm and reduction or elimination of pesticide use.

NATURAL PEST CONTROL

Agroecological approaches to natural pest control strategies go beyond eliminating problem pests, and rather seek to reinforce the interactions of pests and natural enemies in natural ecosystems, maintaining a functional balance with low pest populations. This can be done through understanding and reinforcing the full composite of inherent plant defences, plant mixtures, healthy soils and crops to fend off attacks, natural enemies, and other components of the system, in a web of feedback loops.

CROP-LIVESTOCK INTEGRATION

Integrated crop-livestock systems involve linking crop and livestock production together to generate positive economic and environmental outcomes. Integration is done to recycle resources efficiently, whereby products or by-products of one component serve as a resource for the other – i.e. manure goes to the crops and crop residues feeds animals. The actual relationship between crops and livestock can vary in these systems. It may range from relatively intimate, within-farm integration of crops and livestock (e.g. grazing crop residues after grain harvest) to more indirect relationships (e.g. shared manure application among crop farms within a region).

SOIL BIODIVERSITY

The creatures living in the soil are vital to soil health. They influe[illegible]ure and thus soil erosion and water availability. If healthy and numerous, they can p[illegible]t crops from pests and diseases. They are central to decomposition and nutrient cycling and therefore affect plant growth and amounts of pollutants in the environment.

NITROGEN FIXATION

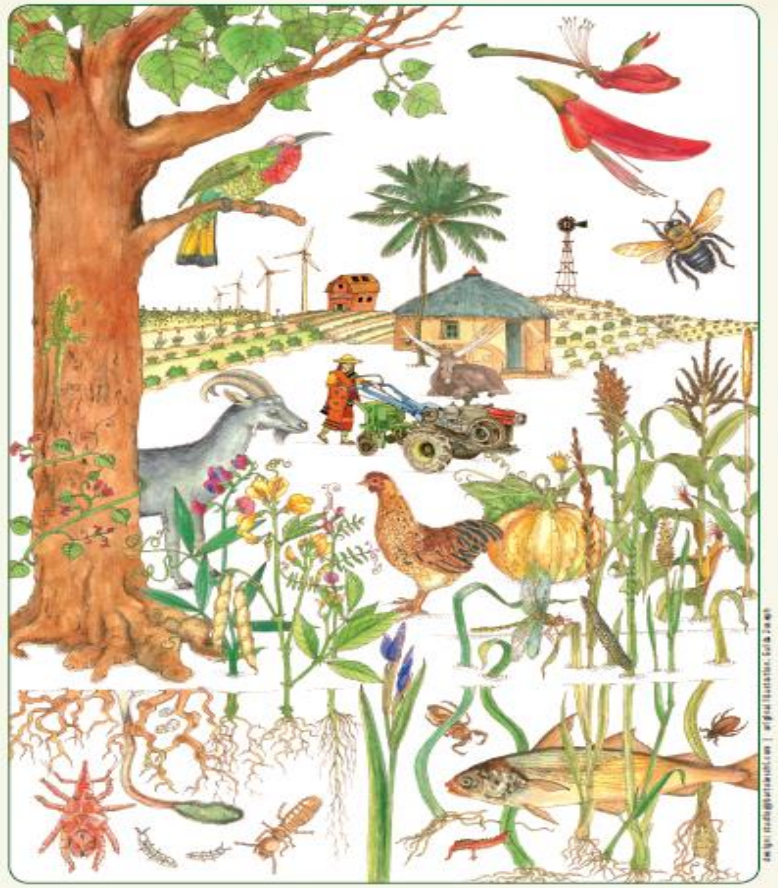
The growth of all organisms depends on the availability of mineral nutrients, and none is more important than nitrogen, which is required in large amounts as an essential component of proteins. There is an abundant supply of nitrogen in the earth's atmosphere - nearly 79% in the form of N2 gas. However, atmospheric N2 is unavailable for use by most organisms and is often the limiting factor for growth and biomass production. Microorganisms such as bacteria have a central role in almost all aspects of nitrogen availability and thus for life support on earth. They can convert N2 into ammonia by the process termed nitrogen fixation; these bacteria are either free-living or form symbiotic associations with plants or other organisms (e.g. termites, protozoa).

DROUGHT RESISTANCE

In the face of climate change, many older crops such as pearl m[illegible] sorghum, are gaining attention. Such crops have multiple attributes: they are inherently drought tolerant, and provide food, feed and – in the case of millet- fuel and construction materials, even in arid conditions. However, agroecological approaches to drought resilience go further, to focus on the diversification of production systems, including polycultures, agroforestry and integration of crops and livestock, along with enhancing biodiverse interactions in the soil and farm.

AGROFORESTRY

Agroforestry is a dynamic, ecologically based, natural resource management system that, through integration of trees on farms and in the agricultural landscape, diversifies and sustains production and builds social institutions. The adoption of agroforestry – a broad suite of ecologically and socially adapted practices – is helping to restore productivity and resilience of landscapes as well as contributing to improving the food, nutrition and income security of smallholders and, especially, other vulnerable groups of society. Agroforestry is based on a sound understanding of agroecology and an improving understanding of the social and economic systems of the people who inhabit these landscapes.



AGROECOLOGY

is the integrative study of the ecology of the entire food system, encompassing ecological, economic and social dimensions. It focuses on working with and understanding the interactions between plants, animals, humans and the environment within agricultural systems. By bringing ecological principles to bear in agroecosystems, through ecological intensification, novel management approaches can be identified, building on key interactions and strengthening virtuous cycles in agricultural production that would not otherwise be considered.

WATER MANAGEMENT

The ways and means of capturing and holding water that might otherwise runoff from agricultural lands is an integral part of agroecology. An agroecological approa[illegible]lls for intensive management of water throughout the agroecosystem, through an integrated [illegible] of surface impoundments, contour ditches, small-scale berms, and basins. Redundancy in wate[illegible]stems is emphasized, with the priority placed first on soil storage, then surface water imp[illegible]ts, followed by tank storage. Water catchment pools, used as reservoirs during dry spells can [illegible] used for aquaculture and by water birds such as ducks.

AQUACULTURE, PONDS AND WETLANDS ON-FARM

Wetlands have high levels of biological productivity and resource potentiality, and can provide multiple services in agroecosystems. They can be used for agriculture, animal-husbandry, and fisheries. Wetlands have also been reclaimed into rice paddies, pastures, forest land and reed production bases. Ecologically, wetlands can not only play a role in flood control, water storage and climate regulation, but can also purify water, improve soil, and increase the species and number of wild animals.

[illegible]ER CROPS AND ROTATION

Planting cover crops in rotation between cash crops is wide[illegible] be ecologically beneficial, providing multiple ecosystem services. Benefits include incre[illegible]on and nitrogen in soils, erosion prevention, more mycorrhizal colonization – beneficial [illegible]gi that help plants absorb nutrients – and weed suppression. Crop rotation, cover crops [illegible] reduced tillage through simple machines such as two-wheeled tractors are three of the basic practices of conservation agriculture.

PERENNIAL CULTIVATION

Scientists are working to breed perennial versions of wheat, rice, sorghum, other grains and other annual crops. Perennials shed some portion of their biomass every year thus replicating the biomass recycling that occurs in natural systems. Root systems of perennial crops are deep and massive, compared to current cultivated grains, and a diversity of soil organisms can flourish. The goals are crops that tap the main advantage of perennials—the deep, dense root systems that fuel the plants' rebirth each spring and that make them so resilient and resource efficient—without sacrificing too much of the grain yield that millennia of selection have bred into annuals.

http://ngm.nationalgeographic.com/2011/04/big-idea/perennial-grains-text

WILDLIFE

Wildlife that eat insects such as birds and bats may have remarkable impacts on insect populations. For example, each year in the spring, millions of Brazilian free-tailed bats migrate northward from Mexico to form enormous colonies in limestone caves and bridges throughout the southwestern United States. Their primary food source is moths including devastating agricultural pests such as the corn earworm or cotton bollworm moth and the tobacco budworm moth and they are key to effective control of these pests that also migrate from Mexico to Texas at this same time. The benefits conferred to agriculture by consumption of these moths by bats may not be limited to their local foraging areas (e.g. in Texas and New Mexico) but may extend to agricultural landscapes hundreds of kilometers away.

Kunz et al. 2011. Ecosystem services provided by bats. Ann. N.Y. Acad. Sci. 1-38.

ENERGY

Making more efficient use of energy has always been a focal point of agroecological practices, and still is for any design of sustainable food systems. In agroecology, the energy efficiency is tightly related with multiple strata silvopastoral systems and crop-livestock integrated managements which are able to host high species richness. Diverse, integrated and self-sufficient agroecological farm systems that employ low levels of external inputs, demonstrate efficiency in the use of water, nutrients and energy, while also being environmentally sound, economically and technically feasible, and socially desired.

From Funes-Monzote et al, (abstract for this symposium) Agroecological management of energy flows to maintain healthy agroecosystems: some general principles and practical examples.

BUILDING COMMUNITIES

Agroecological approaches have strong elements of community building, recognizing that it is the interactions among people that are central to agricultural sustainability and regeneration. Agroecology seeks to build the autonomy of rural communities over management of natural resources and food systems, and their resilience in the face of climate change. The success of many communities in applying agroecological approaches is linked to their social organization and farmer to farmer networks.

Produced as a contribution to the **International Symposium on Agroecology** *for Food Security and Nutrition*


Improve soil nutrition:
Incorporation of legumes in summer crops

Multicropping

Nodules of bacteria associated with the crop roots for fixing nitrogen.

State of Andhra Pradesh, India

Implementation of climate resilient Zero Budget Natural Farming (ZBNF) in the entire state of Andhra Pradesh. The ZBNF program in the first phase has USD 175 million and will cover, 500 000 farmers in 3 000 villages. The vision of the State Government is to universalize this programme to cover all 6 million farmers of the State by 2024.

Food and Agriculture Organization of the United Nations

4 Levels of transition towards Agroecology-based Sustainable Agriculture and Food Systems

- Progressive path towards greater environmental, social and economic sustainability
- From plots / farm level to Agroecosystem level to Food system

The Scaling up Agroecology Initiative

- Aims to accompany and support national agroecology transition processes through policy and technical capacity that builds synergies between countries
- Provides a framework for concerted action with other UN Agencies and partners
- Mobilizes resources to support agroecological transition

Measuring progress in agroecological transition

- Characterize the level of transition to Agroecology based on the 10 elements
- Using the 10 elements as criteria to define semi-quantitative indexes that take the form of scores from 0 to 4
- The scores of the four indexes are summed up and the totals are standardized on a scale from 0 to 100% to obtain the general score for the particular criterion

Main dimension	#	Core Indicators of Performance	SDG	
Environment & Climate change	1	**Soil Organic Matter**	2 15	2.4.1 15.3.1
	1bis	**Soil health**		
	2	**Agrobiodiversity**	2 15	2.4.1 2.5.1
Health & nutrition	3	**Dietary diversity**	2	2.1.1 2.1.2
	3bis	**Food Insecurity Experience Scale (FIES)**	2	**2.1.2** **2.4.1**
	4	**Exposure to pesticides**	3	3.9.1 3.9.2
Social & Cultural	5	**Women empowerment**	2 5	2.4.1 5.a.1
	6	**Youth employment opportunity**	8	8.6.1
Economic	7	**Net income**	1 2 10	1.1.1 1.2.1 1.2.2 **2.3.2**
	7bis	**Stability of income over time**		
	8	**Income distribution**	10	10.1.1 10.2.1
	9	**Productivity**	2	**2.3.1** **2.4.1**
	9bis	**Stability of productivity over time**		
Governance	10	**Secure land tenure (or secure mobility for pastoralists)**	1 2 5	**1.4.2** **2.4.1** **5.a.1**

HOW PUBLIC POLICIES CAN FACILITATE AGROECOLOGY TRANSITION?

PROMOTING AGROECOLOGY THROUGH POLICY FRAMEWORKS

- **AGRICULTURAL POLICY:** The way success is measured in agriculture should be re-examined, moving beyond an emphasis on production alone to include a wider range of considerations –not least sustainable livelihoods, environmental protection and social inclusion.
- **SUPPORTING PLURAL MARKET MODELS**
- **PUBLIC PROCUREMENT PROGRAMMES**
- **INVESTMENTS, CREDIT AND INSURANCE**
- **LAND TENURE AND ACCESS TO NATURAL RESOURCES**
- **RESEARCH, EDUCATION AND RURAL EXTENSION PROGRAMMES**
- **SANITARY AND PHYTOSANITARY MEASURES**
- **COORDINATION AND COLLABORATION IN POLICY AND GOVERNANCE**

Towards agroecological laws

AGRICULTURAL LAWS

They mainly regulate the production obtained through the production of plants and animals and the sale of the results of these activities “

Agricultural law focuses on the regulation of agro-biological production activities, food legislation being one of its derivations

ENVIRONMENTAL LAWS

They cover many of the ecological aspects linked to agricultural activities: biodiversity in agriculture, protection of animal and plant species, agricultural wastes, recovery of contaminated land, agricultural use of water, relations between agricultural and livestock activities and climate change, organic farming, energy production by agriculture; biomass as renewable resources, agroforestry

→ Despite the numerous interferences between the two disciplinary fields, legal doctrine has preferred to keep agricultural and environmental laws separate

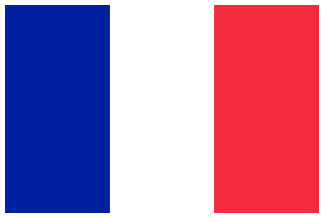
AGROECOLOGICAL LAWS

The current divisive approach used by legal doctrine is not unavoidable and for the future, the gradual construction of a new agroecological law is not a utopia.

On the contrary, there is a concrete possibility

- to legally challenge and renew theoretical models
- to promote legislation and jurisprudence capable of putting into dialogue, on the one hand, areas of law that until now have been separated and on the other hand, law and Agroecology

FRANCE



Law for the future of Agriculture, Food and Forestry

Law N. 2014-1170 of October 13, 2014

Introduction of important changes within the French rural code, so that **Agroecology** is integrated into **legal frameworks and public policies**.

Offers the possibility to create **Group of Economic and Environmental Interest** which is a collective of farmers wishing to engage in Agroecology. They will benefit from a priority or an increase in public support to make a transition to innovative and more competitive production systems.

Other aspects include **support to young farmers**, with credit facilities and access to land for **sustainable food production** with an agroecological approach

URUGUAY

National plan for the promotion of agroecological production

Law No. 19.717

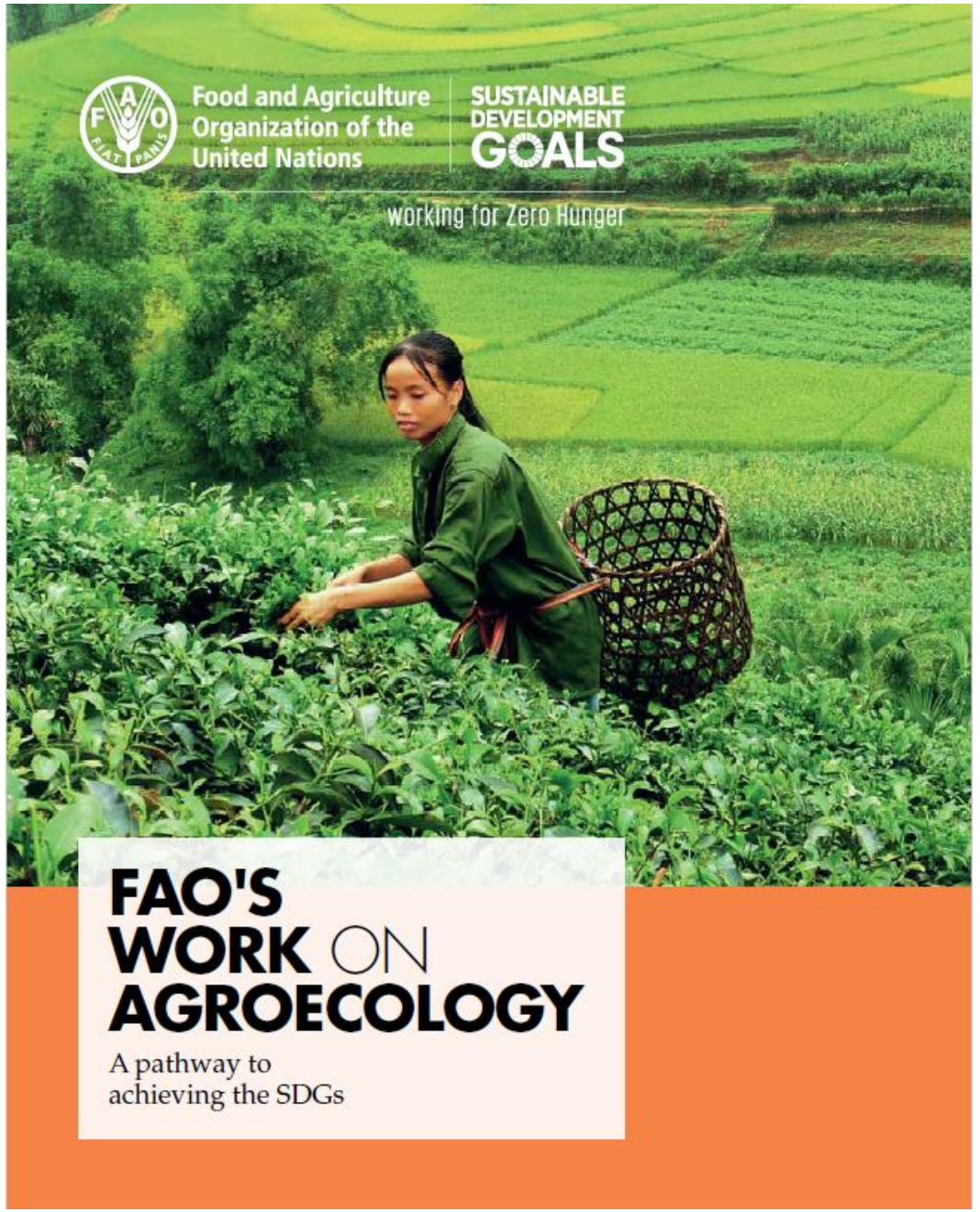
Approved in 2019, it declares of general interest the **promotion of agroecological production, distribution and consumption systems**.

Creates the Honorary Commission responsible for preparing, coordinating and monitoring the implementation and execution of the national plan, with the participation of Ministries, Universities and CSOs.

Among its objectives are:

- Encourage and facilitate the **agroecological transition** and the incorporation of agroecological practices in **agricultural systems**
- Access to **local markets**, favoring the interaction between producers and consumers;
- Promote **training and research** in Agroecology

Thank you


Food and Agriculture Organization of the United Nations
SUSTAINABLE DEVELOPMENT GOALS
working for Zero Hunger
FAO'S WORK ON AGROECOLOGY
A pathway to achieving the SDGs