

AGRO-ECOLOGY
STRATEGIC RESEARCH
AT INRA AND CIRAD



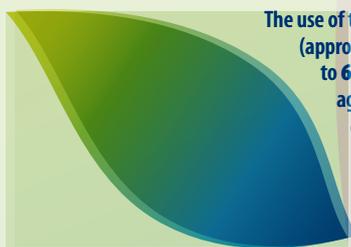
AGRO-ECOLOGY

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As a scientific discipline, agro-ecology is often seen as a cross between ecology and agriculture, aimed at designing and managing sustainable agro-ecosystems. It also draws on economics and social sciences to develop reliable systems and roll them out through appropriate public policy and support mechanisms. Agro-ecology therefore offers a new paradigm for creating sustainable food systems.

In their policy brief, INRA and CIRAD identified agro-ecology as one of their top scientific priorities, in line with:

- societal expectations
- the challenges of sustainable development in the face of global change
- public policy in France (Agro-ecology Project) and several developing countries in favour of agro-ecology
- international initiatives such as those of the UN (Sustainable Development Goals) and the FAO to promote sustainable agriculture.



The use of the term agro-ecology in scientific literature is relatively limited (approximately 1,500 articles since the 1950s). Nevertheless, close to 6,000 articles published each year deal with life sciences within agro-ecosystems, combining ecology, agricultural sciences, environmental sciences and human and social dimensions. For both INRA and CIRAD, agro-ecology is gaining ground quickly as a research topic, with nearly 450 articles referenced in 2014.

AGRO-ECOLOGY, A TRANSITION FOR AGRICULTURE IN DEVELOPED AND DEVELOPING COUNTRIES

AGRICULTURE IN DEVELOPED COUNTRIES

High agricultural productivity has impacted the environment through a loss of biodiversity, an increased uniformity of landscapes, and pollution (soil, air, water). The aim is to find a better compromise between agriculture and the environment in a context of modernization, and regional specialization of agriculture with few farmers and farm workers (2.5% of the population).

AGRICULTURE IN DEVELOPING COUNTRIES

Different types of agriculture are found in developing countries, from major export crops to small-scale family farms that play a key role in food security. Several developing countries are characterized by contrasting climates, exponential population growth, rural poverty, a dearth of jobs in rural areas, and a lack of investments.

Pests often thrive in these conditions, with poor and fragile soils, but there is tremendous potential for innovation based on local savoir-faire.

The aim is to help small family farms adapt to global changes while avoiding the pitfalls of productivist models, and to reconcile agriculture and the environment in the case of intensive cropping systems.

ACROSS THE GLOBE,
A MAJOR AXIS FOR DEVELOPING SUSTAINABLE
AND EFFICIENT AGRICULTURE

FIVE LINES OF RESEARCH TO PAVE THE WAY FOR AGRO-ECOLOGY

1 BOOST BIODIVERSITY AND BIOLOGICAL REGULATION

Boost biodiversity

- Cultivar mixtures, mixed crops and service plants, long crop rotations, agroforestry, biocontrol
- Maximize the production of biomass
- Keep pests and associated diseases in check
- Cut back on the use of pesticides and synthetic inputs.

Renew targets for the genetic improvement of plants and animals

- Take greater account of the biotic interactions between selected plants and animals and their environments
- Develop strategies for using different varieties according to each species
- Develop participatory selection methods.

Plant diversification in the fight against the banana weevil in the West Indies

“Service plants” play a key role in developing agro-ecology systems. In this case, they are used to regulate pests (weevils) in crops by modifying the structure of trophic systems.

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2 OPTIMIZE THE MAJOR BIOGEOCHEMICAL CYCLES

Limit soil erosion, replenish water tables, keep nutrient losses in check

- Close nutrient and water cycles
- Preserve phosphorus, biological nitrogen fixation, and carbon and nutrient storage in soil
- Recycle and make optimum use of manure.

The OasYs dairy system was designed to produce milk and boost savings (Experiment carried out at INRA Lusignan). The introduction of woody species in this mixed multi-crop/livestock system aims to ensure forage supplies, limit heat stress for animals and cover crops, enhance water and nutrient content in deep soil levels, better exploit sunlight, boost biodiversity, and store carbon. © INRA

3 MANAGE LANDSCAPES AND TERRITORIES

- Organize landscape mosaics: plots, interstitial spaces, hedges and wetlands, the role of trees and forests
- Reinforce control of certain pathogens
- Introduce new forms of collective territorial governance
- Develop models for landscape management.

4 EVALUATE AND RE-DESIGN PRODUCTION SYSTEMS

Multi-service systems

- Reinforce services that contribute to productivity and farm revenues and cut back on pesticides and inputs: soil health and organic matter, biological regulation (boosting beneficial organisms, pollination, biocontrol, etc.), ecological services (water cycle, wastewater treatment, recycling, etc.)
- Manage trade-offs between supply services (food, fibres, energy, materials, etc.), regulation services (water cycle, greenhouse gases, pests) and cultural services (associated values) from agriculture and forests
- Evaluate performance and services based on multiple criteria.

Multi-scale performance assessments

The measure of success for households and farms is economic performance (income, employment, vulnerability, dependence). The measure of success for territories is the ability to find new ways of organizing, where negotiating the use of resources takes on particular importance, as does the ability to make compromises

- Define integrated performance indicators
- Make choices to steer agricultural activity within territories.



Changing manure management practices in Africa

On mixed multi-crop/livestock farms in West Africa, the development of innovative practices, in tandem with farmers, to manage organic manure improved soil fertility in three years. © M. Blanchard, UMR SELMET, CIRAD



A “healthy” product label in Vietnam

In developing countries, the reduced use of pesticides in response to demand from consumers comes at an additional cost for farmers. Specific outlets and a new label have been developed to help farmers benefit from higher prices. In and around Hanoi, participating farmers tout their “healthy” produce. © P. Moustier, UMR MOISA, CIRAD

Research by INRA’s Joint Research Unit for Agro-ecology in Dijon aims to equip farmers with robust, easy-to-use and pertinent bio-indicators, to assess the impact of their practices on soil biology (external environmental factors and sustainability of production). Five indicators have been developed: studies on micro-organisms, nematodes, earthworms, structural tests and mineralization assessments. © Fotolia



5 RETHINK INNOVATION SYSTEMS AND EASE TRANSITIONS

Agents of change, be they farmers, consumers, elected officials, resource managers or industrial players, are the ones who take initiatives, run experiments and shape the future of agriculture. To ensure their success, they must:

- have access to information
- build knowledge
- (re)think evaluation criteria
- (re)define benchmarks
- promote cooperation and create new synergies.

In developing countries

Farming strategies and practices, local know-how, markets and industrial sectors are the subject of research:

- Decision-making and negotiating tools for local players
- Assistance for farmers: individual guidance, participatory development workshops
- Design and advice for implementing and evaluating innovation platforms, at local or regional level
- At territorial level, involvement in collective and public programmes.

In developed countries

The organization of agricultural practices can be a stumbling block for alternative solutions. That is why decisions must constantly be revisited. Research helps overcome these obstacles:

- Indicators and specific tools for training and decision support
- New technologies to facilitate observation and interpretation and save time in implementing more complex practices
- Specific tools for certain crop management sequences and systems (sowing under plant cover, mixing crops, agroforestry, etc.)
- Organizing agri-food chains
- Public policy to ease transitions, support land resource management and foster new food systems.



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