

Agro-ecology



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What's CIRAD doing?

In the light of the challenges posed by global change, CIRAD is focusing a substantial part of its research on studying the functioning and development of agro-ecological systems, with a view to developing a credible alternative to conventional production models for tropical and Mediterranean regions.

The agro-ecological transition in the South



CIRAD's work on agro-ecology encompasses several organizational levels – plant, cropping system, farm, rural organization, value chain and territory.

The research approach taken associates diagnoses, knowledge generation and use of local know-how, capacity building and support of innovation processes.

CIRAD is thus building novel interdisciplinary expertise and operational solutions to ensure the agro-ecological transition in farming systems in the South.

CIRAD's position paper on agro-ecology: [Agro-ecology for tropical and Mediterranean farming systems CIRAD's research position](#) (PDF - 101.89 ko)

Three key topics

- Making use of biodiversity : Understanding the biophysical mechanisms and interactions at play within farming systems so as to boost natural regulation processes and resource use efficiency.
- Designing systems: Designing agro-ecological production systems and assessing their performance.
- Supporting transition: Supporting the transition to agro-ecology and the stakeholders involved.

Making use of biodiversity

CIRAD and its partners are studying the biophysical mechanisms and interactions at play within agro-ecosystems with a view to boosting natural regulation and resource use efficiency.

Ecological intensification, the main dynamic under study



Ecological intensification is intended to make resource use more efficient in order to ensure sustainable production and a wide range of ecosystem services, by replacing, as far as possible, the use of synthetic inputs – fossil fuels, fertilizers and pesticides – with the biological functions of cultivated, pastoral and forest ecosystems. It is based on the managed use of functional biodiversity, and is the lynchpin in the development of agro-ecological systems.

Using functional biodiversity to boost farming system performance

CIRAD is focusing a substantial part of its research on understanding natural regulation mechanisms, with a view to:



Improving natural resource use - light energy, water and nutrients – by optimizing biomass production and boosting the efficiency of biogeochemical cycles, for instance using intercrops, cover and service crops, rotations, etc. The main carbon, water and nutrient fluxes between the soil, plants and the atmosphere are being studied on various organizational scales and in line with different cropping practices. The aim is also to understand what determines how plants and plant covers function within a farming system under the effects of the environment and farmer practices.



Controlling pests and diseases, which are particularly important in tropical environments, through appropriate management of biodiversity. CIRAD is studying the effects of the structure of the plant and animal communities found in farming systems on nature and the intensity of biological regulation processes. This work is being fuelled by generating knowledge of host-pathogen relations, the evolutionary biology of populations, and the functional

and trophic ecology of communities. In turn, it is feeding the development of modelling tools that link the agronomic functioning of farming systems and the functioning of trophic networks, and dynamic models of pest and disease development, which serve to draft integrated crop and herd protection strategies and reduce the use of pesticides and other chemical treatments. In a similar way, work is being done to control weeds using service plants.

Examples of CIRAD's research

- [Plant diversification in banana planting - A lever for increasing banana weevil predation](#) (PDF - 227.31 ko)
- [Alternative methods for weeds management in orchards](#) (PDF - 239.63 ko)
- [Agro-ecological crop protection](#)

Renewing the aims of plant genetic improvement

The agro-ecological transition brings new challenges in terms of varietal innovation. Optimizing the biological interactions between a plant and its environment means integrating the local realities of production systems, crop successions and combinations, available biodiversity, etc into varietal improvement operations more effectively. This approach means broadening the range of objectives and selection criteria, considering larger temporal and spatial scales and taking account of local know-how, which is particularly important for farming systems in developing countries. CIRAD is looking into new ways of managing genetic diversity, notably through participatory breeding methods (decentralized dissemination of open-access varietal formulas, multi-genotype breeding, local "refining" of varieties, etc).

Designing systems

Designing agro-ecological production systems means making use of new technical levers and optimizing management of complex biodiversity used in various ways (agroforestry, intercrops, introducing service plants).

A renewed design approach

More appropriate land use fosters the capture of natural resources (intercrops or catch crops, agroforestry systems, multi-species systems, etc); organizing the crops grown within a farming system in spatial and temporal terms serves to boost natural regulation processes; maintaining and improving soil fertility means using service plants that generate nutrition, facilitation and regulation functions (permanent plant covers) and exploiting the complementarity of crop and livestock farming operations.

Multi-criteria and multi-scale assessments of system performance



Innovative systems based on the principles of agro-ecology rely on finding compromises in terms of performance and of resource management, due to the links that exist between the different ecosystem and social functions. Designing "multi-service" systems means pinpointing optimum combinations that allow for the time required to switch from a conventional to an agro-ecological system.

Agro-ecological levers exist:

- on a farm scale, where producers have to strike a balance between various activities in line with changes in their economic context,
- on a landscape scale (installing hedges, refuges or wooded parks, managing fertility transfers and interactions between crop and livestock farming),
- on a territory scale, where producers have to negotiate land use and resource sharing with other players, either individually or collectively.

Cropping system design has to allow for the assessment of performance on these different scales. In this context, associating different functioning models and defining interpretable indicators on these various scales is a huge scientific challenge.

Supporting transition

CIRAD and its partners are studying innovation systems and supporting the various stakeholders in order to help them make the right choices for the transition to agro-ecology.

Inventorying and taking account of local contexts

Agro-ecological transition pathways are strongly dependent on local production conditions and their socioeconomic or institutional environment. Supporting that transition means knowing the constraints, risks, assets and opportunities it brings and giving a central role to innovation processes and to farmers. CIRAD is thus conducting regional diagnoses of a wide range of production systems and environmental and social conditions. Those diagnoses then serve to identify levers that will enable a transition to agro-ecology, on the various organizational levels.

- [Support, monitoring & assessment of the adoption of conservation agriculture in Madagascar](#)

Taking account of how value chains and markets function



While most family farms have links with markets, the economic environment does not always favour agro-ecological innovations. Those innovations have to enable producers to benefit from the major food product markets destined to feed the whole of the population, both urban and rural, and from certain niche markets on which family farms have relative advantages. CIRAD is working on complementary studies of those different markets, how value chains are organized, and the emergence of new marketing methods of greater benefit to producers and consumers.

Developing learning tools for producers



Generating, sharing and using knowledge and information are vital to ensuring the dynamism of rural areas.

CIRAD uses various methods to facilitate participatory learning (primary data gathering, participatory zoning and technico-economic models, local and expert knowledge, smallholder trials, change simulation, etc), which all serve as decision support tools to help individual producers and producers' groups make the transition to agro-ecology.

Developing collective and public action



CIRAD is working alongside professional organizations committed to agro-ecological innovation processes, and helps design, implement and assess local and regional innovation platforms. On a territory scale, it is involved in collective and public action bodies, with the aim of integrating the agro-ecological transition and sustainable resource management more effectively.

These various approaches Foster exchanges between local and scientific knowledge, fuel the debate on practices and regulatory mechanisms, and inform public policy.

Resources

Publications

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Inventorizing and taking account of the range of local contexts

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Science for all

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