



# Agro-silvo-pastoral systems in West Africa

**How can we work with farmers in West Africa  
to design innovative, intensive and ecologically friendly  
crop-livestock systems?**

**F**amily agro-silvo-pastoral systems are in the majority in West Africa. They are the main lever for development. They are also facing a multiplicity of demographic, economic and climatic changes, and their productivity is not making sufficient progress to satisfy the changes in demand. Intensification is the preferred type of pathway to increase the agricultural production, but it exposes farmers and the environment to a range of risks and degradation processes. Action research in partnership serves to design more productive, more sustainable crop-livestock systems based on the principles of ecological intensification.



Photos: E. Vall / CIRAD

## Partners



**Centre International de Recherche-Développement sur l'Élevage en zone Subhumide (Cirdes).**



**Institut de l'environnement et de recherches agricoles (Inera).**



**Institut d'économie rurale (IER).**



**Université Polytechnique de Bobo-Dioulasso > Institut de Développement Rural (UPB/IDR).**



**UPGC > Université Péléforo Gon Coulibaly (Korogho).**



**Cirad > Research Units: INNOVATION, SELMET, AGAP, AIDA.**



M. Havard / CIRAD

## Associates

**West Africa >** farmers' organizations and territorial authorities; NGOs and development support organizations; State services (agriculture, livestock, health, environment); West and Central African Council for Agricultural Research and Development.

**France and Europe >** research and higher education establishments (INRA, Montpellier Supagro).

**Global >** ILRI, ICRISAT, CIAT, CIFOR (CGIAR); Commonwealth Scientific and Industrial Research Organisation (CSIRO, Australia).

## Beneficiaries

**Rural farming households** will be able to boost production sustainably thanks to innovations based on the principles of ecological intensification.

**Farmers' organizations and development support bodies, policy-makers and the local authorities** will benefit from new knowledge and instruments of use in supporting more intensive, more ecologically friendly farming.

**Students, researchers and current and future management staff** will be able to build their skills in the whole range of disciplines and fields of use in designing such systems.

The **scientific partners** will boost their scientific reputation by publishing their work in international journals.



E. Vall / CIRAD



E. Vall / CIRAD

# Expertise and technical skills

- > Analysis of the dynamics of crop-livestock systems (local practical know-how, innovations).
- > Analysis of agricultural advice services and territorial governance and changes.
- > Modelling of biomass and nutrient flows within farms and territories.
- > Co-design of technical and organizational innovations (action research in partnership).
- > Building stakeholders' capacities and support of innovation (organizations and advice to farms, authorities and decentralized natural resource management).
- > Multi-criteria assessment methods and studies of the impact of innovations (establishment of indicators and methods).
- > Project identification, feasibility studies, management and assessment (*ex-ante*, mid-term and *ex-post*).



E. Vall / CIRAD

## Some current projects



E. Vall / CIRAD

### Sustainable intensification options • OID, 2011-2015, AusAID/WE CARD € 2M

Boosting farm productivity will not be sufficient to meet demand. Intensifying production also raises sustainability issues. The OID project is using multi-stakeholder platforms to promote combined crop and livestock farming and thus generate massive, sustainable intensification effects.



P. Djamen Nana

### Agro-ecology-based aggradation-conservation agriculture • ABACO, 2010-2015, European Commission/FSTP, € 3.5M

With the disappearance of fallow, soil organic fertility has to be managed differently. The project has identified production systems compatible with the principles of conservation agriculture, and modelled and tested cropping systems that make use of soil covers and cereal-legume intercropping.



E. Vall / CIRAD

### Environmental efficiency and sustainable livestock production • EPAD, 2010-2015, ANR-France/Systerra, € 0.9M

The ability of a system to produce the maximum effect with the minimum of resources lies at the heart of agro-ecology. The project is looking at the energy and environmental efficiency of crops-livestock farms, and has demonstrated that combining crop and livestock production helps to improve that efficiency.



E. Vall / CIRAD

### Support of cotton supply chain governance, productivity, and farm sustainability • PASE II, 2014-2016, AFD-France/R&D Component, € 1.7M

When the rate of change speeds up, decisions have to be made based on up-to-date, local information. To facilitate steering on a supply chain and collectivity scale, the project has set out to develop an information system on agrarian dynamics. To boost farmers' incomes, it will be working with their organizations to come up with innovations.

### ASAP, a platform with some forty researchers and teaching staff members and around ten PhD students

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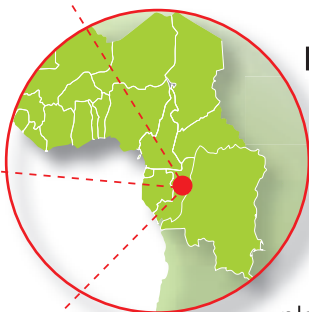
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# Sustainable production of industrial crops in Congo

Photos : CRDPI



**How can we ensure the economic, ecological and social sustainability of fast-growing forest species production?**

In a highly constrictive environment (low mineral fertility, water deficits, land tenure conflict), improving and maintaining productivity requires significant ecological intensification of plantations and their integration into the local socioeconomic fabric.

This platform contributes to the development of planting material that is highly efficient in terms of mineral and water resource use. It tests new crop management sequences that use and export little in the way of resources.

Lastly, action research in partnership enables the co-construction of production and logging systems for the common benefit of local populations.

## Partners



**Délégation Générale à la Recherche Scientifique et Technique** Supervisory body for public research centres.



**Eucalyptus Fibre du Congo (EFC)** Industrial forest plantation company.



**CIRAD** Joint research units: AGAP, Eco&Sols; Internal research unit: B&SEF.



## Associates

**Congo >** Université Marien Ngouabi; Ecole nationale supérieure d'agronomie et foresterie; Service national de reboisement; Programme national d'afforestation et de reboisement; Centre de recherche sur la conservation et la restauration des terres; Ecole nationale des eaux et forêts.

**Africa >** Research and training centres; NGOs; project design firms.

**France and Europe >** Numerous research and higher education establishments; industry; etc.

**International >** CIFOR [CGIAR]; major organizations.

## Beneficiaries



**Industrial and family planters** can improve production sustainably using the new crop management sequences and clones available to them.

**Future senior technical staff working for the State and forestry or development firms** can benefit from training in the higher education sector.

The **scientific partners** have trials that give their work generic value by testing their approach under tropical conditions.

They can also boost their scientific visibility by publishing in international journals.

**Students, future management staff and researchers** benefit from research training through research.

**Politicians** have access to new knowledge and instruments in order to draft the leading strategies relating to forest and rural development.

## Expertise and technical skills

- > Water and nutrient balances in forest ecosystems, pedology, ecophysiology, functional ecology.
- > Planted forest management and development.
- > Forest tree breeding and improvement, quantitative genetics.
- > Nursery techniques and plantlet production.
- > Technological characterization of woods.
- > Socioeconomic analyses of supply chains (fuelwood, charcoal, game).
- > Social impacts of forest certification.
- > Studies of environmental impacts.
- > Geographical information systems.



CRDPI

## Some current projects

**Ecological intensification of planted forest ecosystems. Biophysical modelling and socioeconomic assessments of the introduction of nitrogen-fixing species in eucalyptus plantations** • Intens&fix, 2011-2015, ANR, € 1M

Nitrogen is the main nutrient that limits eucalyptus growth in Congo. By studying biogeochemical cycles, the project is working to develop crop management sequences that combine nitrogen-fixing plants with eucalyptus production, which serves to enrich the soil with nitrogen. The dissemination of improvement crop management sequences to growers should enable the development of less fertile areas and may encourage at least some farmers to become sedentary.



CRDPI

**CRDPI Sustainable production of industrial crops in Congo**

**A platform with six researchers and teaching staff and five Masters and PhD students.**

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CRDPI

**Analysis of the genetic and environmental determinism of water use efficiency with a view to improving the sustainability of eucalyptus plantations** • WUEtree, 2014-2016, ANR, € 0.5M

In environments with a water deficit, water use efficiency is either directly or indirectly a major selection criterion. Knowing the factors that determine the variability of water use efficiency and that of the characters associated with it serves to define ideotypes and steer the selection methods to be used to achieve efficiency.



CRDPI

**Development of a crop management sequence for *Eucalyptus citriodor* essential oil production** • Huiles essentielles, 2013 - 2016, SNR, € 30K

At the request of the Forestry Ministry, the CRDPI is running experimental demonstration plots for small-scale rural operators keen to enter this niche market. The CRDPI is working upstream of the supply chain, on intensification of leaf biomass production.

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# Agro-ecological pest management in West Africa

How can we make use of natural regulation processes for sustainable management of crop pests and diseases (pathogens, pests and weeds)?

Climate change and the expansion of agriculture at the expense of natural areas are threatening ecosystems that play a role in natural regulation of crop enemies. In a context in which demand for agricultural goods is soaring in line with population growth, the network's multi-partner structure is helping develop appropriate crop protection strategies, which boost the productivity of farming systems (producing more) and reduce farmers' reliance on pesticides (producing better).



P. Silvie - H. de Bon - S. Simon/CIRAD

## Partners



**International Institute of Tropical Agriculture (IITA)**, member of the CGIAR.



**Institut national de recherches agricoles du Bénin (Inrab)**.



**Agricultural Science Faculty, University of Abomey-Calavi (FSAUAC)**.



**Institut d'économie rurale (IER)**.



**Science and Technology Faculty, Cheikh Anta Diop University (FST-UCAD)**.



**Gaston Berger University, Saint-Louis-du-Sénégal (UGB)**.



**Institut sénégalais de recherches agricoles (Isra)**.



**Cirad** > Internal Research Units: AIDA, HortSys.



P. Menozzi/CIRAD

## Associates

The agreement between the network's partners ensures:

**In the three countries in the region (Benin, Mali, Senegal)** > substantial capacity to support agricultural development; multi-partner links with national research and education systems; close ties between research and universities (courses, MSc and PhD supervision); the dissemination and pooling of tools, methods and knowledge.

**In Africa** > the support of the West and Central African Council for Agricultural Research and Development (WECARD) and its institutional partners.

**Globally** > partnerships with the CGIAR (Afri-caRice and IITA), the EU and USAID (USA).

## Beneficiaries

**Producers** help implement appropriate cropping practices and targeted, localized control strategies.

**Village communities** can set up plot patchworks to encourage antagonists, parasitoids, pathogens or predators of pests and diseases and slow pest spread.

**Policy-makers** have analyses, methods and instruments for supporting the dissemination of such strategies.

**Scientists** and **students** can build their skills through training and the dissemination and pooling of tools and methods developed by agronomy and ecology (ecological intensification, ecosystem services, landscape ecology, etc).



H. de Bon/CIRAD

## Expertise and technical skills

- > Advice and methods in relation to cropping techniques, to ensure quality products while minimizing input use, particularly pesticides.
- > Pest and disease diagnoses and development of monitoring-assessment methods.
- > Coordination of integrated, sustainable pest and disease management projects.
- > Methodological backup for the design of research and development programmes in the field of agro-ecology.
- > Agro-economic modelling of multi-species farm functioning.
- > Agro-economic feasibility study of tropical horticultural products and tropical annual crops; assessment of their environmental impact.

J. Huat/CIRAD



## Some current projects

### Low cost pest exclusion and microclimate modification technologies for small-scale vegetable growers in East and West Africa • BioNetAgro, 2010-2013, USAID, 385 k€

The aim is to design systems to ensure physical protection of horticultural crops, such as insect nets in Benin, in addition to other control methods, to limit pesticide use. The direct and indirect impacts of these technologies on the insects, plants and their environment are being assessed. The socio-economic aspects are also being studied.

S. Simon/CIRAD



### Improving the productivity of rice/ market garden bottomland zones in West Africa • RAP, 2011-2014, European Commission € 2.4M

The aim is to exploit the agricultural potential of bottomland zones in sub-Saharan Africa by intensifying and diversifying rice-based systems, while maintaining the environmental services they provide. A participatory action research approach is being adopted with the various stakeholders, with a view to designing sustainable integrated rice-market garden crop cropping systems.

T. Brévault/CIRAD



### African weeds of rice • AFROWEEDS, 2010-2013, European Commission, € 732k

The aim is to set up the first Afro-European knowledge- and experience-sharing network with respect to the control of weeds affecting rice-growing systems. An identification support software package and a database with almost 200 different weed species found in East and West Africa are two of the results of the project.

P. Marrotte/CIRAD



### DIVECOSYS, a platform with 40 researchers and teaching staff members and numerous Masters and PhD students

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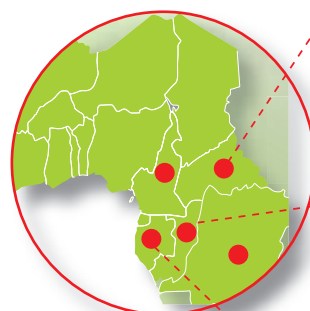




# Forests of central Africa

How can we improve policies, strategies and modes of intervention on every level so as to ensure the long-term preservation of the forests of the Congo Basin and the food security of the people who derive a living from them?

The preservation of the forests of the Congo Basin and of the services they provide lies at the heart of many environmental, agro-economic, social, governance and territorial issues. Research is supporting efforts to improve forest management and forestry policy, understand the effects of global change and study and preserve biodiversity.



Photos: D. Louppe/CIRAD - S. Gourlet-Fleury/CIRAD



D. Louppe/CIRAD

## Partners

### AFRICA

**Five forest countries in the Congo Basin**  
Cameroon, Congo, Gabon, Central African Republic, Democratic Republic of Congo.

**Commission des forêts d'Afrique centrale**  
(COMIFAC) and associated institutions.

**Congo Basin Forest Partnership** (CBFP).

**Ministries and public bodies in the five countries.**

**Universities and national research centres.**

**Regional higher education establishments**  
eg: École régionale postuniversitaire d'aménagement et de gestion intégrés

des forêts et territoires tropicaux (ERAIFT, DRC), Ecole de faune de Garoua (EFG, Cameroon).

### INTERNATIONAL

**NGOs** WWF, Hanns Seidel Foundation.

**CGIAR** CIFOR, ICRAF.

### EUROPE

**French and European universities and higher education establishments** eg: Universities of Montpellier (France), Liege (Belgium), Aberdeen (UK), Bayreuth (Germany), Wageningen (WUR, Netherlands).

**Research centres** eg: IRD, CNRS.

**CIRAD** Internal research units: BSEF, BioWooEB; Joint research unit: ECOFOG.

## Beneficiaries

**Each and every user of the forests and the fringes of protected areas** is involved in managing natural resources using participatory methods.

**Forest managers** are able to implement very innovative management schemes that are the fruit of decades of research and are setting the standard for sustainable management of forest concessions.

**National, regional and international political and financial decision-makers** are involved in the assessment and implementation of innovative financial mechanisms.

**Researchers, management staff and future management staff** have access to high-level training and supervision (Masters, PhD, post-doc, and vocational and certificate training).

**Scientists** can boost their visibility within the international scientific community.



D. Louppe/CIRAD

# Expertise and technical skills

- > Support of public policy and donor strategies.
- > Project identification, feasibility studies, management and assessment (ex-ante, mid-term and ex-post).
- > Monitoring of biodiversity and climate change: knowledge of logged forest dynamics, recommendations.
- > Helping the public and private sector manage productive forests.
- > Sustainable plantation management, restoration of degraded forests.
- > Fuelwood supply chains: knowledge of the resources available from natural and planted forests, studies of economic operators (transport, processing, marketing).
- > Bushmeat: knowledge of practices and support of operators to work towards better sustainability.
- > Environmental services, taxation: assistance with assessing and implementing new economic instruments.
- > Observatories: Observatory for Central African Forests (OFAC), protected areas, land tenure.



D. Louppe/CIRAD

## Some current projects

**Consolidating the Observatory for Central African Forests and extending it to protected areas** • CEOFAC, CEOFAC, European Commission, 2010-2014, € 1.9M, OBAPAC, other funding sources, 2013-2014, € 0.9M

By consolidating the Observatory for Central African Forests (OFAC) and extending it to the six COMIFAC countries and other forest regions in Africa, the long-term aim is to alleviate poverty among the local people who depend on the African forests and to guarantee the sustainability of environmental services. These projects are a continuation of the FORAF project, which set up OFAC.



D. Louppe/CIRAD

**Sustainable management of fuelwood** • Makala, European Commission, 2009-2014, € 3.3M

Wood is the main domestic fuel resource in central Africa, and is under growing pressure. The Makala project ("ember" in Lingala) set out to ensure sustainable management of natural and planted periurban forest resources while improving supply chains. Its activities centre on Kinshasa and Kisangani (Democratic Republic of Congo) and Brazzaville (Republic of Congo).



D. Louppe/CIRAD

**Forest dynamics in concessions** • DynAffor, FFEM, 2013-2017, € 0.7M CoForTips, ANR-France, 2013-2015, € 0.4M

CoForChange revealed a series of forest types with very different dynamics of change. It served to draft recommendations for land planning players to help them decide on priority wood production zones and areas to be protected. DynAffor is continuing these studies with a view to drafting rules for wood use that take account of the ecological functioning of tree stands and the variability of environmental conditions.

CoForTips is looking further into CoForChange research issues, adding a socioeconomic component.



S. Gourlet-Fleury/CIRAD D. Louppe/CIRAD

PP FAC,

**Forests of central Africa**

**Some thirty researchers and teaching staff and 15 Masters or PhD students**

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# Forests and Biodiversity in Madagascar

How can biodiversity conservation and improving living conditions for local people be reconciled?

The biodiversity of the primary forest in Madagascar is a global treasure that must be preserved. However, this cannot be done at the expense of the people whose livelihoods depend on its many uses. The platform is working to address a dual challenge – preserving the forest and alleviating poverty – by involving local communities in the conservation and sustainable use of natural resources and the ecosystems in which they are found. To this end, its research is both multidisciplinary and conducted on various scales.

## Partners



### University of Antananarivo

> Graduate School of Agricultural Sciences (ESSA); Science Faculty; Law, Economics, Management and Sociology Faculty (DEGS); Arts and Human Science Faculty.



### FOFIFA >

Department of Forestry and Fishery Research (DRFP); Department of Research and Development (DRD); Department of Zootechnical and Veterinary Research (DRZV).



Livia Andrianolaina

## Associates

**Madagascar >** Universities of Tamatave and Fianarantsoa; research and development institutes; State services (forestry, environment, health, energy, agriculture); Agence de développement de l'électricité rurale (ADER); Silo national des graines forestières (SNGF); industry; NGOs; project design agencies; communication agencies.

**Africa >** research and training centres; NGOs; project design agencies; etc

**France and Europe >** many research and higher education establishments; industry; etc

**Global >** CGIAR, leading organizations.

## Beneficiaries

**Local producers** can boost their incomes through resource management contracts (training, usage quotas, etc).

**Politicians** and **local authorities** have access to knowledge, tools and methods for participatory resource management.

**Students, future management staff** and **researchers** can build their skills in the whole range of disciplines and fields of use to the management and sustainable use of resources.

**Scientific partners** can boost their reputation through regular co-publications in international journals.



P. Danthu / CIRAD



S. Aubert / CIRAD

## Expertise and technical skills

- > Sustainable natural resource management, techniques for exploitation and for adding economic value that both respect the environment and help conserve biodiversity (wood and non-wood products, fuelwood).
- > Information management for forest monitoring: remote sensing, spatial analysis, geomatics and mapping.
- > Information systems: databases, drafting and fuelling of monitoring and assessment indicators applied to sustainable natural resource management.
- > Public policy support (law, economics, land tenure, environmental and sectorial policies, etc), new economic instruments, and participatory local management.
- > Project identification, feasibility studies, management and assessment (ex-ante, mid-term and ex-post).



J.-M. Bouvet/CIRAD

## Some current projects

### Sustainable natural resource management and biodiversity conservation •

Cogesfor, 2009-2014, AFD/FFEM-France, € 1M



P. Montagne/CIRAD

The aim is to develop community management of forest and grazing areas on the fringes of protected areas in the Alahotra Mangoro region and on the Mahafaly plateau, biodiversity hotspots in Madagascar. By exploiting natural resources using controlled, contract-based approaches, it is possible to foster the conservation of fragile zones within an environment that is viable for the local population.

### Agroforestry for food security • AFS4food, 2012-2015, European Commission/African Union, € 0.75M

Three African countries are involved in the project and are sharing their experience of managing different agroforestry systems: based on cocoa in Cameroon, coffee in Kenya and cloves in Madagascar. A network that conducts research and share tools, experiences and recommendations of use to farmers and extension workers to ensure that combining agroforestry and food crops bears fruit.

### Biomass energy for decentralized rural electrification •

Bioenergelec, 2010-2014, European Commission/ACP-EU Energy Facility, € 2M



P. Montagne/CIRAD

In rural areas of Madagascar, there are substantial, little-used biomass resources. The aim is to test electricity generation from local biomass using steam generators in six rural communities chosen for their contrasting situations in terms of available biomass and demand for electricity for domestic and/or small-scale commercial purposes.



P. Danthu/CIRAD

### F&B, a platform with some sixty researchers, teaching staff members and PhD students

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# Agroforestry systems in central Africa

How can we develop sustainable, high-yielding agroforestry systems that satisfy demand from the agricultural sector, particularly family farms?

In central Africa, a significant proportion of agriculture relies on complex agroforestry systems, primarily cocoa- and coffee-based, which contribute to the incomes and diets of millions of rural households. In the current situation of growing pressure on natural resources, such systems, which combine environmental service and production functions, can help improve living conditions for local people. The aim of the platform is to assess the performance and sustainability of such systems in all their diversity, and to support decision-making by producers

## Partners



**Institut de recherche agricole pour le développement (Irad)**  
> Scientific coordination: tree crops and production systems.



**University of Yaoundé 1** > Science Faculty, plant biology, animal biology and physiology, and biochemistry departments.



**University of Dschang** > Agronomy and Agricultural Science Faculty (FASA).



**Cirad** > Internal Research Units: Pests and Diseases, BSEF; Joint Research Unit: SYSTEM.



S. Dépligny/CIRAD

## Associates

**Cameroon** > State services, development organizations and producers' associations and groups (GIC), with which trials have been conducted for more than 10 years.

**Africa** > national research centres and universities (Ghana, Ivory Coast and Nigeria); NGOs; technical centres (Centre technique horticole de Tamatave, Madagascar); West and Central African Council for Agricultural Research and Development (WECARD); African Centre for Research on Banana and Plantains (CARBAP).

**Latin America** > a similar structure, AFS-PC PP (coffee- and cocoa-based agroforestry systems).

**France and Europe** > IRD, Montpellier SupAgro, University of Montpellier II (France), University of Gembloux (Belgium).

**Global** > World Agroforestry Centre (ICRAF), Institute of Tropical Agriculture (IITA), Coffee Research Foundation (CRF), World Cocoa Foundation (WCF).

## Beneficiaries

**Rural populations** will be able to boost and diversify their sources of income through intensification and intercropping (biodiversity). Improving their living conditions will help alleviate poverty.

**Public and private bodies** will have access to information and tools to support the performance of small-scale family agroforestry farms and those in the agricultural sector, and sustainable management of agricultural and agroforestry land.

**Students, researchers and current and future management staff** can build their skills and benefit from certificate courses intended to meet farmers' expectations better. They will boost recognition of their work by publishing in international journals and symposiums.

Working together allows the **scientific partners** to build a new dynamic and a critical mass of skills with a view to establishing innovative projects.



G. Rok



M. Ten Hoopen/CIRAD

## Expertise and technical skills

- > Development of sustainable pest and disease management strategies
- > Varietal creation, improvement and breeding.
- > Agroforestry production system design.
- > Training for farmers, technicians, students and researchers ("Devenez expert en cacao" [become a cocoa expert]; on-line course in the sociological approach to agroforestry systems).
- > Carbon stock assessment.
- > Support for promoting ecosystem services.
- > Soil fertility diagnosis.
- > Biodiversity assessment.

R. Babin/CIRAD



## Some current projects

### Ensuring synergy between agroforestry and food crop systems • AFS4food, 2012-2015, European Commission, € 750k

Three African countries are involved in the project and are sharing their experience of managing three different agroforestry systems: cocoa-based in Cameroon, coffee-based in Kenya, and clove-based in Madagascar. The project will generate products and recommendations of use to farmers and extension workers keen to ensure a fruitful association of agroforestry and food production.



M. Ten Hoopen/CIRAD

### Improving the overall productivity of cocoa-based agroforestry system • Tradeoffs in Cocoa, 2011-2014, World Bank, WECARD, € 750k

Agroforestry is an interesting alternative for the ecological intensification of systems in which cocoa is generally grown as a monocrop, at the expense of forest. This project will supplement our knowledge of how to optimize cocoa production and provide ecosystem services (biodiversity, carbon sequestration, etc), and build farmers' capacity to increase their incomes and diversify their outputs.



G. Kok

### Helping to improve cocoa- and coffee-based agroforestry systems in Cameroon • C2D Agroforesterie, 2014-2016, France (contrat Désendettement-Développement / debt relief-development contract), € 430k

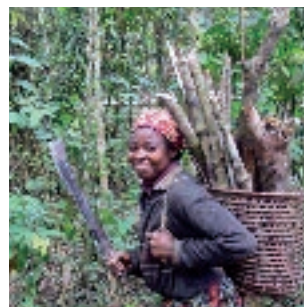
This project, which falls under a Franco-Cameroonian contract totalling € 8M involving IRAD and CIRAD, involves applied research into ecological intensification and biological regulation of pests and diseases. To improve the performance of cocoa- and coffee-based systems, priority will also be given to disseminating improved varieties.



S. Depigny/CIRAD

### Finding compromises between the products and ecosystem services provided by agroforestry systems • SAFSE 2012-2015, AIRD, € 600k

Analyses of the compromises and synergies between the supply services and the ecosystem and cultural services provided by agroforestry systems form the heart of this project. The aim is to shed light on choices with a view to ensuring better food security for farming households through autonomous, diversified production activities, while contributing to the increased resilience of agrosystems in the face of global change.



R. Petitier/CIRAD

### Agroforestry Systems in Africa, a platform with 25 researchers and teaching staff members and 15 Masters and PhD students

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a set of partners keen to work together;  
shared prospects and objectives;  
a commitment in terms of human resources,  
equipment and funding; a shared research  
topic; a specific geographical field;  
a range of skills and activities.

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# Public Policies and Governance in southern Africa

How can we support the drafting and implementation of new public policies in southern Africa, while taking account of the restructuring of local and international governance bodies and instruments?



R. Ducrot - M. Bourblanc - A. Caron / CIRAD

When it comes to rural development and natural resource management, a clearer understanding of the changes in public action, the connections between the different levels on which decisions are made, the multiplicity of organizations and players (public and private), and the historical and cultural links between institutional frameworks, modes of governance and the instruments associated with them should enable a more effective response to the concerns voiced by our local and global partners. The aim is also to engage discussion and contribute to the debate on governance issues.

## Partners



**University of Pretoria >**

Faculty of Natural and Agricultural Sciences, Department of Agricultural Economics; Post-Graduate School of Agriculture and Rural Development; Centre for Environmental Economics and Policy in Africa; Political Science Department



**Center for the Study of Governance Innovations (GOVINN).**



**CIRAD > Joint Research Units:**

ART-DEV, G-EAU, MOISA, INNOVATION.



N. Ferrand / UMR G-Eau

## Associates

**In southern Africa >** Government and national and provincial ministries (South African Presidency; Department of Water Affairs; Provincial Department of Agriculture of the Western Cape; Provincial Department of Agriculture, Limpopo); regional platforms (FANRPAN - Food, Agricultural and Natural Resources Poverty Analysis Network); national and international research centres (IWMI - International Water Management Institute; IWECA, - International Center for Water Economics and Governance in Africa); local NGOs (AWARD - Association for Water and Rural Development).

**Global and in France >** Associations of members (International Land Coalition; International Consortium for Comparative Water and Development Studies); international organizations (NEPAD); numerous research centres.

## Beneficiaries

**Political decision-makers, local authorities and non-governmental players** have a clearer understanding of the processes through which more equitable, integrated and sustainable public policies are drafted and implemented. They have access to analysis tools and methods for designing and organizing participatory management of natural resources.

**Students, future management staff and researchers** can build their skills in the whole range of disciplines and fields of use in drafting public policy as regards the management and sustainable use of resources.

**Scientific partners** can build their research capacity and boost their international reputation.

S. Farolfi / CIRAD



E. Torquebiau / CIRAD



## Expertise and technical skills

- > Public policy support (law, economics, land tenure, environmental and sectorial policies, etc), analyses of new economic instruments, and of participatory local management schemes.
- > Support of local, national and global decision-makers and players, including through multi-player and multi-level structures, and by strengthening stakeholders' associations (producers' organizations, etc), with a view to drafting fairer, better integrated, sustainable public policies.
- > Project identification, feasibility studies, management and assessments (ex-ante, mid-term and ex-post).



E. Torquebiau / CIRAD

## Some current projects

### Large-scale land transaction monitoring •

Land Matrix, 2012- ..., multiple funding sources, € 1M



T. Durand-Gasselin / CIRAD

Land Matrix is an independent global initiative aimed at monitoring large-scale land transactions. The partner organizations are particularly interested in the decision-making processes within those transactions. Land Matrix provides tools that foster greater civic involvement in those processes, notably by making information available that is easily understood by all. By promoting transparency and striving to make decision-makers accountable for their decisions, the aim is to improve decision-making processes relating to land resources and their use.

[www.landmatrix.org](http://www.landmatrix.org)  
Partners: CDE, CIRAD, GIGA, GIZ, ILC.

### Tools for integrated natural resources management in Africa •

AfroMaison, 2011-2014, European Commission, € 4M



R. Duclot / CIRAD

The aim of AfroMaison is to help make the integrated natural resource management concept operational by building a toolbox and a multi-disciplinary analysis framework in order to put it into practice. The idea is to go beyond a mere juxtaposition of the available management tools: those relating to functioning and landscape planning (erosion control, desertification, deforestation and water resource degradation), to socio-economic development conditions, to local knowledge and practices, to the strengthening of institutions, etc. Several participatory natural resource management options are suggested, all based on a prior study of the

challenges and opportunities and anchored in the local traditions and culture.

[www.afromaison.net](http://www.afromaison.net)

Partner: CIRAD, ICRAF, IWMI, Mountain of the Moon University-Kenya, UNESCO-IHE, University of KwaZulu-Natal, Wetlands International.

**PP6G, a platform with  
six researchers and teaching  
staff members,  
seven associate researchers  
and 11 PhD and  
16 Masters students**

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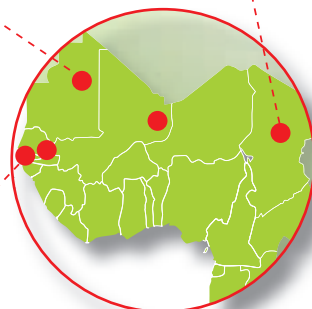




# Pastoralism and drylands in Senegal

Understanding and working to develop pastoral systems and integrate them into national economies.

In spite of the widespread crisis affecting the Sahel, pastoral livestock production is still a major way of life and production system in the arid zones of Africa. Within this context, its sustainability depends on its ability to preserve natural environments and co-exist with other activities. The platform is working towards sustainable pastoral livestock production that is better integrated into national economies and fits in with other production systems in dry zones.



Photos: I. Touré / CIRAD

## Partners



**Centre de suivi écologique (CSE).**



**Institut sénégalais de recherches agricoles (ISRA).**



**Cheikh Anta Diop University, Dakar (UCAD).**



**CIRAD** Joint research units: SELMET and TETIS, Internal research unit: GREEN.



I. Touré / CIRAD



C. Corniaux / CIRAD

## Associates

**Africa >** West and Central African Council for Agricultural Research and Development (WECARD), Comité permanent inter-Etats de lutte contre la sécheresse dans le Sahel (CILSS), AGRHYMET regional centre; colleges and universities in West Africa; West African Economic and Monetary Union (WAEMU); State services, territorial authorities; NGOs; farmers' organizations (Billital Maroobé network, APESS), dairy supply chain operators; Spatial Information Systems in West Africa PP (SISTO) and Agro-silvo-pastoral Systems in West Africa PP (ASAP).

**France and Europe >** Research and higher education establishments (INRA, Montpellier Sup-Agro, University of Wageningen, Universities of Paris, IRD), NGOs (GRET, IRAM, AFL, CA17, CARE, AVSF)

**International >** CGIAR (ILRI, IFPRI), FAO, World Bank

## Beneficiaries

**Producers** can consolidate their pastoral activities long term.

**Policy-makers and territorial authorities** have knowledge, tools and methods at their disposal to enable them to reconcile economic development, social harmony and successful pastoral activities.

**Students, future management staff and researchers** can build their skills in the range of disciplines and fields linked to pastoralism.

**Scientific partners** can boost their visibility by publishing regularly in international journals and through increased collaboration with development partners.



C. Corniaux / CIRAD

# Expertise and technical skills

- > Participatory design of management methods and land tenure policies suited to pastoralism.
- > Multi-scale assessments of the impacts of herd mobility on nutrient cycles.
- > Analyses of transhumance and cross-border trade in the Sahel.
- > Analyses of animal product supply chains in West Africa.
- > Analyses of risks and food security.
- > Design of ecosystem services to ensure sustainable intensification of extensive livestock systems.
- > Design of decision support tools and modelling tools for the Sahel.
- > Higher education and adaptive research: GIS, economics of pastoralism, ecology, socioeconomics, sociology (practices, local know-how) and geography.



C. Corniaux / CIRAD

## Some current projects



I. Touré / CIRAD

### Livestock systems and climate change • ANIMAL-CHANGE, 2011-2015, European Commission, DG Research, € 12M

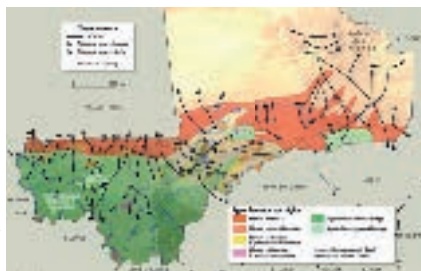
For the first time, a forward-looking, integrative vision of the possible futures for the livestock production sector in Europe, North and Sub-Saharan Africa and Latin America that takes account of climate change is available. The aim is to design sustainable development systems for livestock production.



I. Touré / CIRAD

### Tropical agro-agro-ecosystems in the face of global change • CERAO, 2014-2017, ANR-France, AgroBiosphère, € 627k

The aim is to satisfy growing production requirements by placing ecosystems at the heart of processes. The concepts developed through the sciences of ecology and complexity are being used to analyse viable, sustainable agro-socio-ecosystems. Such approaches serve to determine the key rules to be respected when steering future agro-ecological intensification programmes.



I. Touré / CIRAD

### Observatory of livestock mobility in the Sahel • OPTIM-AOC, 2013-2014, International Land Coalition, € 20k

En Through a web mapping platform, the initiative set out to map, watch and inform changes in rangeland use and the subsequent effects on pastoral mobility (transhumance corridors, pastoral reserves, commercial routes, etc) in West and Central Sahelian Africa.



P.D'Aquino / CIRAD

### Modelling and sustainable development • MODEV, 2011-2014, Agence Universitaire de la Francophonie, € 38k

MODEV set out to provide sustainable development players with shared representation tools and methods, computer models and sociological analysis grids tailored to their requirements. The project's main success so far has been the co-design and provision of a platform that integrates these various tools, specifically for stakeholders in charge of managing pastoral resources.

### DP PPZS, Pastoralism and drylands 16 researchers and teaching staff, 20 Master and PhD students

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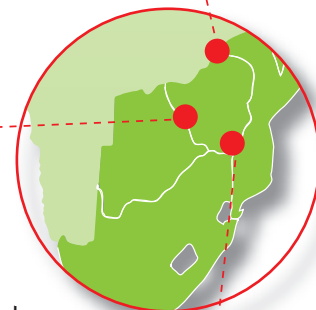




# Production and Conservation in partnership in southern Africa

How can the sustainable development of rural populations be combined with biodiversity conservation in zones of substantial interaction between man and nature?

**T**rans-Frontier Conservation Areas (TFCAs) of southern Africa are complex socio-ecosystems in which African savannas are shared between traditional agricultural activities and African wildlife. For farming systems already fragile as a result of climatic, economic and political constraints, the interactions between people and the environment are often fraught with conflict (crop destruction by elephants, or poaching). Research is helping managing those conflicts and promote the sustainable use of natural resources by encouraging farming practices respecting the environment and biodiversity.



Photos: A. Caron / CIRAD



## Partners



**University of Zimbabwe** > Departments of Geography and Environmental Science, Animal Science and Biological Science; Centre for Applied Social Science; Faculty of Veterinary Science; Tropical Ecology Programme.



**National University of Science and Technology** > Faculty of Forest Resources and Wildlife Management.



**CNRS** > Institut de l'écologie et de l'environnement.



**CIRAD** > Internal Research Units: AGIRS, AIDA, BSEF, GREEN; Joint Research Units: AMAP, INNOVATION, MOISA.



D. Cornells / CIRAD

## Associates

**Zimbabwe** > Agricultural and environmental technical services; animal health services; development and conservation NGOs (CAMPFIRE).

**Southern Africa** > Universities in South Africa, Mozambique, Zambia and Botswana; AHEAD network.

**France and Europe** > Numerous research and higher education establishments.



A. Caron / CIRAD

## Beneficiaries

**Livestock and crop smallholders on the fringes of conservation areas** find solutions to their conflicts with wildlife in the parks (crop destruction, livestock predation, veterinary diseases and zoonoses) and are able to test sustainable ways of using natural resources.

**Students, future management staff and researchers, from Zimbabwe and SADC**, can build their skills in the whole range of disciplines and fields of use to agricultural development and the management and sustainable use of resources in the specific context of trans-frontier conservation areas.

**The scientific community** has published more than 80 articles in international journals and book chapters since 2007, most of which have students as their main author.

## Expertise and technical skills

- > Natural resource governance and sustainable management: environmentally friendly use and economic exploitation techniques that help conserve biodiversity.
- > Agriculture and conservation in the semi-arid zones of southern Africa.
- > One Health approaches to manage infectious diseases at the interfaces between man, livestock and wildlife (from the ecology of wild and domestic ungulate behaviour to analyses of the risks of zoonoses).
- > Functional ecology in complex ecosystems, community and behavioural ecology, remote sensing, science of geography.



A. Caron / CIRAD

## Some current projects

### Strengthening of research capacity for management of protected areas and their periphery • RenCaRe, 2013-2015, MAE, € 500K

The aim is to support national structures and research organizations in Zimbabwe by setting up and managing a competitive research fund to support innovative projects and enable junior researchers working within the platform to take certificate academic courses, with the support of experienced researchers.



A. Caron / CIRAD

### Delivering innovation and technology through the reinforcement of agricultural and multi-disciplinary research capacity for the benefit of small-scale farms in TFCAs •

EU-DREAM, 2014-2017, European Union, € 2M

The project aims to (re)connect academic research and technical support services (agricultural, environmental and animal health services) with the private sector and small-scale local producers on the fringes of trans-frontier conservation areas. It trains future management staff from technical services and universities in the specific issues relating to these interfaces between man and nature within the framework of participatory, targeted research projects.



A. Caron / CIRAD

### Geomatics technologies transferred to animal health services in three southern African countries • EU-GeosAf, 2013-2015, European Union, € 1M

This project trains units specializing in mapping and spatial studies within animal health services in Mozambique, Zimbabwe and Botswana, in order to improve the surveillance and control of animal diseases such as trypanosomiasis and tick-borne diseases. It associates technical training and field studies, and equips the units with the necessary equipment to ensure that they can work effectively.



A. Caron / CIRAD

**A platform with some seventy researchers and teaching staff members and 70 Masters and PhD students trained or in training since 2007.**

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CIRAD Regional Office:  
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# Spatial information systems territories and observatories in West Africa

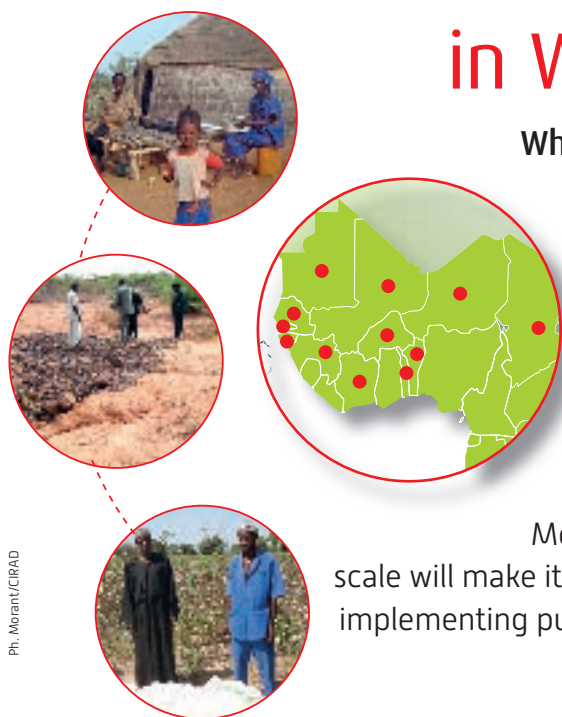
PP 10

What information and sharing and support mechanisms are required for public policy players, particularly in order to respond to food insecurity in West Africa?

Food insecurity affects vulnerable people in both rural and urban areas. It depends on the accessibility of food goods (which depends on agricultural output), climatic risks, market functioning and consumer income levels.

More detailed, precise and better quality data on a territory scale will make it possible to inform those in charge of drafting and implementing public policy in terms of food insecurity.

Ph. Morant/CIRAD



## Partners



**Permanent Interstate Committee for drought control in the Sahel (CILSS).**



**West and Central African Council for Agricultural Research and Development (WECARD).**



**Ministry of Agriculture and Food Security, Burkina Faso (Le MASA).**



**National research institutions (INERA, IER, INRAN).**



**Universities of Bamako and Ouagadougou.**



**Private higher education establishment for space and telecommunications studies (ISESTEL).**



**Commonwealth Scientific and Industrial Research Organisation (CSIRO), land and water division, which is involved in research applied to agricultural development in West Africa.**

**Skills network in sustainable territorial development and spatialized information management design (RIDGIS).**



**CIRAD** Joint research units: TETIS, SELMET, MOISA and CIRED.



Ph. Morant

## Associates

**West Africa >** National services in charge of food security, Comité inter-états (CILSS), Food and Agriculture Organization of the United Nations (FAO), World Food Programme (WFP), Famine Early Warning Systems Network (FEWSNET), European Community Humanitarian Aid Office (ECHO), UNICEF, Oxford Committee for Famine Relief (OXFAM), Action contre la faim (ACF), Save the Children.

The SISTO platform is also committed to developing South-South and South-North research networks and building its partners' skills.

## Beneficiaries

To draft and implement public policy, **governments and the main international institutions** have access to new knowledge and detailed, precise information on the food situation.

**Scientists in both North and South** are improving knowledge and characterization of food insecurity. This enables them to propose alternatives to current systems and to promote their results by publishing in international journals.

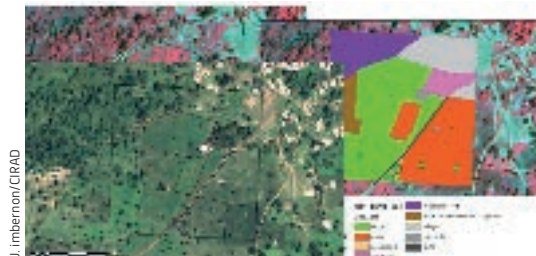
**Students, future management staff and researchers** can build their skills in the range of disciplines and fields of use in designing such systems.



Ph. Morant/CIRAD

# Expertise and technical skills

- > Food security in relation to food crop production and price volatility models
- > Rangeland management
- > Management of spatialized information and information systems
- > Training [databases, geographical information systems, remote sensing, decision support tools].



J. Imbert/CIRAD

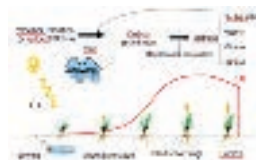


M. Passouant/CIRAD

## Some current projects

### Development of a crop monitoring model suited to tropical countries, partnership with the AGRHYMET regional centre, (SARRA-H, 1990-2015)

SARRA-H is a crop model for use in analysing the impact of climate on dry cereal growth and forecasting potential yields in tropical environments (<http://sarra-h.teledetection.fr/>). The model has been adapted to the requirements of meteorological services in West Africa (17 countries concerned) and transferred to their staff via training courses.



Cirad - Agrhymet

### FARMAF project - Burkina Faso - 2012-2015 • European Union, € 4 710 000

Improving agricultural revenue and food security for less favoured rural populations by developing and transferring certain tools already implemented in various African countries. Those tools include agricultural insurance, warranting and market information systems. The results will subsequently be used to develop holistic management of agricultural risk.



E. Maître D'Hôtel/CIRAD

### Participatory land tenure observatory, pilot phase in the Lake Guiers zone, Senegal, OPVF, 2014-2015 • IRD-SREC, € 5000

The project is developing and implementing instruments to monitor and discuss land attribution and use, with a view to strengthening governance of land tenure and protecting the most vulnerable groups.



I. Toure/CIRAD

### Observatory of rangelands and of the integrity of transhumance and commercial corridors for livestock mobility in West and Central Sahelian Africa International Land Coalition, OPTIM-AOC, 2013-2014 • Donor: International Land Coalition \$ 27 500

Through a web mapping platform, the initiative set out to map, watch and inform changes in rangeland use and the subsequent effects on pastoral mobility (transhumance corridors, pastoral reserves, commercial routes, etc.).



I. Toure/CIRAD

### Skills network in sustainable territorial development and spatialized information management design, RIDGIS • international scientific association governed by Burkinabe law, founded in 2012, € 25 000/year

This associative network was set up on the initiative of several partners in West Africa, in collaboration with CIRAD, to provide a forum for debate, exchanges of experience, discussion and training as regards information systems and GIS to benefit rural development. RIDGIS provides training sessions in DB/GIS for rural development, and has already trained around sixty management staff members in the development of information management tools.



Ph. Morant/CIRAD

## The SISTO network associates a dozen institutions of various types, and around thirty scientists.

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# Highland production systems and sustainability in Madagascar

How can we boost agricultural production on family farms in the highlands of Madagascar, while preserving natural resources?

In Madagascar, population growth and low agricultural productivity are a threat to food security.

In highland regions, declining soil fertility, pest attacks and socioeconomic constraints all limit production. The aim of the platform is to contribute through research to optimizing the interactions between farming activities and production system sustainability.

## Partners



**FOFIFA** > Antsirabe regional research station (SRRA); Lake Alaotra agricultural research centre (CALA), Rice research department (DRR); Zootechnical and veterinary research department (DRZV).



**FIFAMANOR** > Research department; Animal husbandry department.



**University of Antananarivo** > College of agricultural science (ESSA); Radio isotopes laboratory (LRI); Science Faculty.



**IRD** > Functional Ecology & Bio-geochemistry of Soils & Agro-ecosystems Research Unit (Eco&Sols).



**CIRAD** > Internal Research Unit: AIDA; Joint Research Units: SELMET, INNOVATION, TETIS.

## Associates

**Madagascar** > Research/development institutes; GSDM; development projects; NGOs; State services (agriculture, livestock production).

**Indian Ocean** > Research/development institutes; universities; commodity chains.

**Africa** > Research and training centres; AfricaRice Center; universities; NGOs.

**France and Europe** > Numerous research and higher education establishments.

**International** > CGIAR; major organizations.

## Beneficiaries

With the support of **development actors, crop and animal farmers** are benefiting from new upland rice varieties, improved cropping systems based on conservation agriculture, organic fertilizer quality, pest control methods, etc.

Thanks to training through research, supervision of theses and hosting of internships, **students and future management staff** are able to build their skills in the fields of sustainable agricultural and livestock production.

**The scientific partners** are able to enhance their visibility through regular co-publications in international journals.



# Expertise and technical skills

- Improving productivity and quality of upland rice. Creation of improved varieties of upland rice.
- Integrated pest management: characterization of their dynamics, modification of their impact under the combined effect of different management practices.
- Design, adaptation and dissemination of sustainable, innovative cropping systems. Methodological support for the drafting of R&D programmes in the field of agro-ecology. Recommendations and testing of direct seeding equipment.
- Assessment of the agronomic and environmental performance of cropping systems.
- Optimum use of feed resources by animals, recycling livestock farming effluent to fertilize crops, modelling of interactions.
- Integrated fertility management: characterization of soil biological and geochemical dynamics as a function of cropping systems and soil types, soil-plant mineral transfers and cycles, quantification of the fertilizer value of organic residual products.
- Characterization of farmer strategies and analyses of innovation processes within farms and producer groups.
- Characterization of the spatial structure of environments and activities by analysing satellite images and databases.

J. Dussenne / CIRAD



**SPAD, a platform with around thirty researchers and teaching staff members and 20 Masters and 15 PhD students qualified or currently studying since 2007**

## Some current projects

**Recycling plant and animal biomass in crop-livestock farming systems • BIOVA, 2013-2015, European Commission/African Union, € 1M**

The project is working to secure food production within family farming systems. It is structuring and heading a scientific exchange network on a regional level. It develops tools and methods for characterizing resources and validates and transfers agro-ecological techniques aimed at conserving and optimizing use of the resources available on farms. It supports the acquisition of knowledge and promotion of innovative agro-ecological techniques aimed at optimizing management of the resources produced or available within farms.



E. Tillard / CIRAD

E. Penot / CIRAD

**Conservation agriculture in rice cropping systems in Madagascar: sustainability and adoption • CARIM, 2013-2016, Fondation Agropolis Open Science, € 150k**

The project funds grants for stays in France, training activities and the organization of high-level scientific events aimed at: 1) understanding and optimizing soil bio-functioning and the efficacy of fertilizer use in conservation agriculture; 2) assessing the impact of conservation agriculture systems on overall performance and environmental

services in the field; 3) conducting socioeconomic analyses of the adoption of conservation agriculture systems.

**Agronomic management of resistance to rice blast • GARP, 2010-2014, ANR Systerra, € 730k**

The aim is to measure the effects of conservation agriculture on the expression of upland rice resistance to blast. The project set out to identify the mechanisms involved, placing the emphasis on nitrogen uptake dynamics.



M. Sester / CIRAD

T. Becquer / IRD

**Characterization of cropping systems and their productivity using multi-source remote sensing and data mining, to ensure food security • TOSCA, 2013-2015, CNES, € 71k**

To support food security early warning systems, the project will be supplying new products of a future satellite mission [SENTINEL-2]. It will be exploring new remote sensing data processing and analysis methods enabling mapping of various types of cropping systems and better estimates of agricultural production in the highlands near Antsirabe, in Madagascar.

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shared prospects and objectives;  
a commitment in terms of human resources,  
equipment and funding; a shared research  
topic; a specific geographical field;  
a range of skills and activities.

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# Conservation agriculture in Southeast Asia

A network aimed at producing more while preserving resources.

Population and economic pressure has driven agricultural intensification in Southeast Asia. It has also increased the pressure on available land, inducing substantial degradation of natural resources. Conservation agriculture (CA) aims to enhance ecological processes, to preserve and restore soil fertility, mitigate climate change and foster farm sustainability. The major potential for dissemination of such climate-smart innovative systems is being supported by a wide range of stakeholders. CANSEA set out to structure these initiatives on a regional scale.

## Partners



**Ministry of Agriculture, Forestry and Fisheries (MAFF) Cambodia**



**Yunnan Academy of Agricultural Sciences (YAAS), China**



**Indonesian Agency for Agricultural Research and Development (IAARD), Indonesia**



**DALaM « Department of Agriculture and Land Management », Laos**



**Kasetsart University (KU), Thailand**



**Northern Mountainous Agriculture and Forestry Institute (NOMAFSI), Vietnam**



**Soils and Fertilizers Research Institute (SFRI), Vietnam**



**University of Queensland (UQ), Australia**



**CIRAD**, Internal research unit: AIDA, Joint research unit: G-EAU



## Associates

**Universities and national faculties of agriculture** > [eg: Nabong Faculty of Agriculture, Laos, Royal University of Agriculture and University of Battambang, Cambodia].

**Authorities, State services** > [eg: national and local extension and information services in Laos and Vietnam].

**Non-governmental organizations** > [eg: Sayabouri Development Fund, AgriSud, and GRET in Laos].

**Producers' organizations** > [eg: maize groups in Laos and Cambodia].



## Beneficiaries

The strategy is to pool relevant resources from **member institutions** to target the CA-related research, education/training and outreach constraints and challenges faced by resource-poor farmers and educators/policy-makers in Southeast Asia. These operations boost regional recognition of the network.

**Scientists** can build their knowledge and partnerships on conservation agriculture, centring on issues relating to ecological intensification.

**Students and future agronomists** have access to a wide-ranging education network (host universities and field facilities).

**Policy-makers** have a clearer idea of the issues linked to ecological intensification of agricultural practices and the conditions required to facilitate the dissemination of conservation agriculture.

**Producers** are better equipped to respond to environmental constraints (erosion, soil fertility, climate variability and climate change) and rapid socioeconomic change.

## Expertise and technical skills

- Design, assessment and steering of innovative cropping systems.
- Characterization of agricultural development strategies and analysis of innovation processes on farms.
- Recommendations for sustainable improvement of the productivity and quality of annual crop-based rainfed cropping systems.
- Integrated management of fertility and characterization of biological and geochemical dynamics, soil-plant transfers and mineral cycles.
- Integrated management of pests and diseases: characterization of dynamics, modification of their impact under the combined effect of various management practices.
- Adaptation of no-till planters based on interactions between stakeholders.
- Fodder resource use by animals, recycling of livestock production effluent to fertilize crops, modelling of interactions.
- Characterization of the spatial organization of landscape and activities through analyses of satellite images and databases.



H. Tran Quoc/CIRAD

## Some current projects

### Agriculture and climate change in Laos • EFICAS (Eco-friendly Intensification and Climate-resilient Agricultural Systems) EU-AFD, 2014-2017, € 2.6M

This project fits in with a programme to develop the mountainous regions of northern Laos (NUDP). The aim is to engage village communities from five provinces in northern Laos in an innovation process including the adoption of agro-ecological practices through a territorial approach that would enable them to adapt better to climate change. Alternative practices are being proposed, implemented on a smallholder landscape scale, and assessed using participatory methods. In particular, the project will be promoting the results of previous pilot projects in Laos.



P. Girard/CIRAD

### Enhancing ecological intensification for resilient small-scale farming in Cambodia • CASC (Conservation Agriculture Service Centre), 2008-2014, € 1M

Established in 2014, CASC stems from previous projects funded by AFD and SANREM CRSP (USAID). The aims are to co-design with local communities diversified CA systems in the rainfed and flooded agrosystems of central and northwestern Cambodia, and to fine-tune these systems through farmer feedback, assessing the evolution of technical and economic performance, and reviewing the constraints in order to suggest and test measures to facilitate and scale up the adoption process. Activities also include the conservation and propagation of the wide plant diversity required to design innovative cropping systems.



Pham Thi Sen/INOMAFSI



R. Boulianne/CIRAD

### Developing agro-ecology in mountainous zones in Vietnam • ADAM (AFD, CIRAD), 2009-2014, € 1.4M

Following on from the SAM project (agrarian systems in mountain regions) and the project to develop the tea-growing sector Phu Tho province, the project aims to disseminate conservation agriculture in three mountainous provinces of northern Vietnam. Direct seeding, mulch-based cropping systems (DMC) are being developed and disseminated for annual crops grown on slopes. Agro-ecological innovations are being tested for tea plantations.

### CANSEA network, Conservation Agriculture in Southeast Asia

20 researchers and teaching staff, 5 Masters and PhD students

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CIRAD Regional Office  
<http://asie-sud-est.cirad.fr/>

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# Emerging diseases in Southeast Asia

**How can we manage the emerging health risks at the interface between animals, man and their environments?**

**S**outheast Asia is a hotspot in terms of disease emergence, due to a number of converging factors: climate change, deforestation, urban growth and changing production conditions and market chains. The GREASE network promotes a “One Health” approach, taking account of the interdependence of social and epidemiological dynamics, biodiversity and health, and veterinary and human public health in order to address such complex health risks.

## Partners



**Gadjah Mada University** > Faculty of Veterinary Medicine.



**National Veterinary Research Institute** > Cambodia (NAVRI)



**National Institute of Veterinary Research** > Vietnam (NIVR)



**Central Mindanao University** > Faculty of Veterinary Medicine, Philippines (CMU)



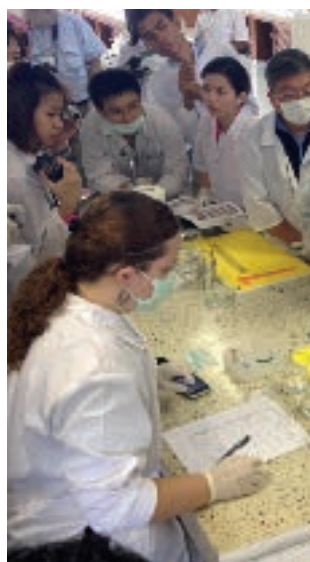
**Kasetsart University** > Faculty of Veterinary Medicine, Thailand (KU)



**National University of Laos** > Faculty of Agriculture (NUOL)



**CIRAD** > Internal Research Units: AGIRs, GREEN; Joint Research Units: INTERTRYP, MOISA, QUALISUD



GREASE

## Associates

**Southeast Asia** > Institut Pasteur (Cambodia); Thammasat, Chiang Mai, Kon Kaen and Mahidol Universities, Thailand; University of Gadjah Mada (Indonesia); University of Hong Kong; Asian Institute of Technology (AIT); national veterinary services.

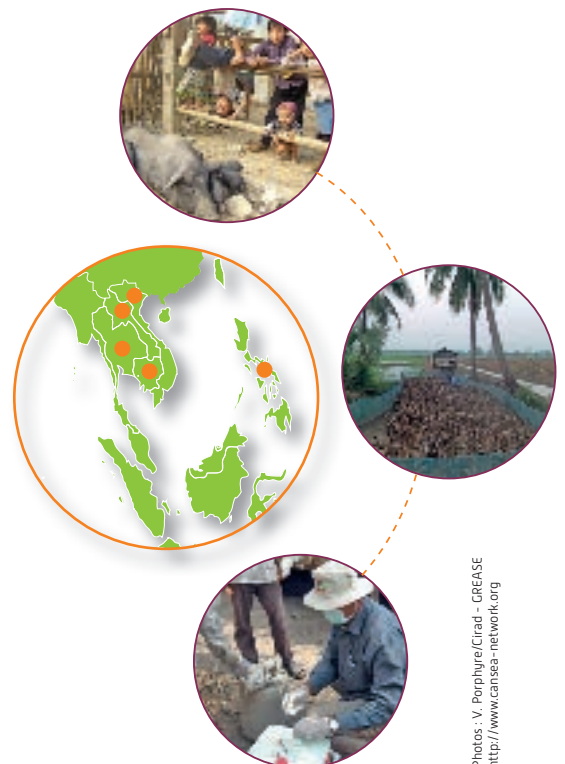
Extension of the network's activities to southern China and other organizations in the Southeast Asian islands (Malaysia and the Philippines) is under way.

**France** > IRD, CNRS, ENVT.

**Worldwide** > OIE, FAO Emergency Centre for transboundary animal diseases; Regional Office for Asia and the Pacific (ECTAD-RAP).



GREASE



Photos: V. Porphyre/Cirad - GREASE  
<http://www.caisea-network.org>

## Beneficiaries

**Scientists and decision-makers** will boost their knowledge of the dynamics of emergence and transmission and develop surveillance tools.

**French and Asian students** will benefit from training that enables them to take an integrated approach to health risk analysis, within a One Health conceptual framework.

**Human and veterinary public health, environment and rural development stakeholders** will be backed up by knowledge and data that take account of the epidemiological, socio-economic and environmental data for Southeast Asia.

**Producers, livestock supply chain operators, the authorities and local communities** will build their skills and organize epidemic surveillance and prevention.



GREASE

## Expertise and technical skills

- > Analysis and assessment of health surveillance systems within a multidisciplinary (epidemiology, social sciences, parasitology, ecology, modelling, etc) and cross-sectoral framework (veterinary services, public health, environment and forestry, and rural development).
- > Interactions between biodiversity and health: analysis and perception of health risks at the animal/human/environment interface, ecosystem services (disease regulation), from a local to a global level, vulnerability and resilience of socio-ecosystems with regard to health risks.
- > Assessment of the surveillance, control and impact of animal diseases and zoonoses, taking account of the various stakeholders' risk perceptions and management schemes.
- > Development of participatory approaches and modelling tools to address health risks within a One Health approach: capacity building, establishment of projects in partnership, vocational training and higher education sessions.
- > One Health education: "InterRisk" international Masters, implemented by Kasetsart University [Faculty of Veterinary Medicine] and the École Nationale Vétérinaire de Toulouse [ENVT-INPT], coordinated by CIRAD.



Phan Dang Thang/CIRAD

## Projects (examples)



GREASE

### Companion approach for cross-sectoral collaboration in health risk management • ComAcross, European Union, 2014-2018, € 2.2M

The overall aim is to build capacity and share knowledge among various One Health stakeholders through field work (heterogeneous data management) and training (academic and vocational). The project implemented a case study-based approach addressing: 1) the management of health risks associated with flooding (Thailand); 2) Japanese encephalitis dynamics (Cambodia); 3) parasitic zoonoses of livestock in small-scale farming systems (Laos); and 4) Nipah virus dynamics (on a regional scale) within the framework of a One Health/Ecohealth approach.



V. Hebréteau/IRD

### Local impacts of global change: biodiversity, health and zoonoses • BiodivHealthSEA, ANR-France, 2012-2015, € 521k

Rodents are reservoirs of major zoonoses (leptospirosis, scrub typhus, etc). In Southeast Asia, they are also good indicators of modifications in the natural habitat and in the interactions between humans and their environment. The aim is to obtain original data on the relations between biodiversity conservation, land occupation, local farming practices and risk perceptions, and disease spread.



J.C. Maillard/CIRAD

### Assessment of surveillance systems in Southeast Asia • REVASIA, MAAF and AFD-France, 2008-2017, € 465k

The aim is to develop generic tools for the assessment and modelling of animal disease surveillance systems (notably avian influenza) that could be applied in both industrialized and developing countries. The project is working on methods that combine veterinary and human medicine approaches, and multi-agent models.



GREASE

### Reducing the morbidity and mortality associated with infectious encephalitis • Southeast Asia encephalitis, SEAE, 2012-2017, € 1.3M

This project, coordinated by the Institut de Pasteur in Paris, aims to reduce morbidity and mortality resulting from infectious encephalitis in Southeast Asia. In many cases, little is known about the causes of these diseases, which may be down to various pathogens, including emerging ones. It is mainly the poorest people who suffer the consequences, since they have limited access to health care systems.

### GREASE network, emerging diseases in Southeast Asia

Around 60 researchers and partner teaching staff members, 10 students (Masters or PhD) per year, 250 members (GREASE mailing list)

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CIRAD - C. Bottier, Ph. Thaler, F. Gay



# Hevea research platform in Southeast Asia

How can rubber smallholders adapt to global challenges?

**G**lobal industry depends on millions of family rubber farms for a very specific raw material: natural rubber (NR). Rubber is primarily grown in tropical Asia, and is booming, since it provides growers with regular incomes and requires little in the way of inputs. The platform covers a broad range of environmental conditions, from traditional rubber-growing zones in the South to expanding zones in the North, through an integrated, multi-disciplinary approach.

## Partners



**Kasetsart University (Bangkok)**, the largest agricultural university in Thailand.



**Prince of Songkla University (Hatyai)**, the largest university in southern Thailand.



**Rubber Research Institute of Thailand (DOA-RRIT)**.



**CIRAD** Internal research unit: Performance of Tree Crop-Based Systems; Joint research unit: IATE, ECO&SOLS, AGAP.



B. Chambon/CIRAD

## Associates

These members take part in targeted operations, in line with their scientific speciality or their network.

**In Thailand** > three universities (Mahidol, Khon Kaen, Ubon Ratchathani), a research institute (Biotec) and a development agency (ORRAF).

**In France** > IRD, INRA, Montpellier Supagro, University of Montpellier 2, Blaise Pascal University, University of Maine.

**In the region** > rubber plantings are a key element in the very rapid agrarian change under way in the Greater Mekong region. The HRPP has close links with the Land Use Changes and Ecosystem Services international joint laboratory (LUSES, IRD and partners), which is studying that change, particularly in Laos and Thailand. It also has a partnership agreement with the Sustainable Rubber in Mekong Region project (China-Germany) in Yunnan.

## Beneficiaries

**Local producers** can increase and secure their income. They will find it easier to grasp the possibilities of planting in new areas.

**National and international organizations** have knowledge, tools and methods at their disposal to enable them to strike compromises between the different ecosystem services provided by rubber plantings.

**Producers, processors and consumers** benefit from criteria for assessing natural rubber technological properties, and also its environmental footprint.

**Students, management staff and researchers** can build their skills as regards the different stages in the supply chain, from planting to processing.

**Scientific partner** can boost their visibility through regular co-publications in international journals.



B. Chambon/CIRAD



Ph. Thaler/CIRAD

## Expertise and technical skills

- > Tapping systems suited to clones and plantation types, to ensure sustainable rubber tree management.
- > Tapping system diagnoses based on bark consumption (panel diagnoses) and latex vessel physiological condition (latex diagnosis, LD). Establishment of LD laboratories.
- > Environmental impact of rubber plantations: carbon and water flux measurements and balances within plantations, identification and measurement of functional biodiversity indicators.
- > Analyses of the biochemical composition and structure of NL and latex, establishment and measurement of technological quality indicators.
- > Design and completion of agro-economic surveys and supply chain analyses.



C. Bottier/CIRAD

## Some current projects

**Toward the improvement of the rubber tree productivity** • DORAS Rubber, 2010-2016, Thailand International Cooperation Agency, € 0.3M

This project, at the Thailand International Development Cooperation Agency (TICA) provides the platform's institutional framework. Its scientific programme overlaps with that of the HRPP, with five research fields: plantation productivity, impact of global change on small-scale farm productivity and sustainability, social and environmental impacts of NR production, planting material performance, and NR quality variability.



Ph. Thaler/CIRAD

**A platform with around a hundred researchers, teacher-researchers and students.**

### Thailand

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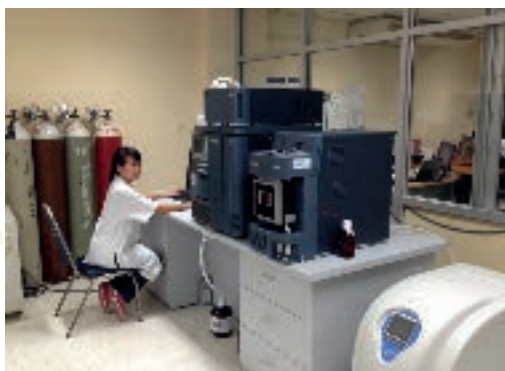
F. Gay/CIRAD

**Nutrition and fertilization of rubber plantations** • Yara, 2013-2017, Co., € 0.5M

In Thailand, fertilizer recommendations for rubber plantations vary significantly depending on the source, whereas there have never been any research results that clearly show a link between fertilization and latex production. In collaboration with a Norwegian private firm, Yara, one of the world's leading mineral fertilizer manufacturers, a multi-disciplinary study is under way to understand farmers' practices better and ensure sustainable, environmentally friendly production.

**Lipolgreen Asia and PHC SIAM (Franco-Thai projects)** • Agropolis Fondation, € 0.15M

Part of the advantage NR has over its synthetic rivals can be attributed to the non-rubber compounds it contains. However, those compounds (fats and proteins) may also contribute to the inconsistency of NR, which makes it difficult to use. Understanding the nature and influence of NR fats and proteins better, combined with farmers' practices, will help in promoting this natural product, with a view to ensuring sustainable production.



C. Bottier/CIRAD

### For further information

Project website:  
<http://hrpp.ku.ac.th/>

CIRAD Regional Office  
<http://asie-sud-est.cirad.fr/>

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# Markets and agriculture linkages for cities in Asia

How can sustainable food supplies to urban areas be reconciled with local agricultural development?



Between 2000 and 2010, urban population growth in Asia was running at 2.7% per year, ie another 378 million inhabitants. In order to feed cities and satisfy growing demand for diversity, safety and quality, value chains are restructuring and farming systems are being transformed.

Urban markets create opportunities but also challenges for local farming systems. How should food supply chains be reorganized? How can we stabilize incomes among the least favoured farming populations? How can we reconcile sustainable food supplies to cities with local agricultural development?

Photos: D. Sautier - J.C. Maillard - J.C. Maillard/CIRAD

PP 15

## Partners



**CASRAD** > Centre for Agrarian Systems Research and Development at the Food Crops Research Institute (FCRI)..



**FAVRI** > Fruits and Vegetables Research Institute.

Both are members of the Vietnam Academy of Agricultural Sciences (VAAS).



**RUDEC** > Rural Development Centre, Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD).



**Faculty of Agriculture, National University of Laos (NUoL).**



**CIRAD** > Joint research units: INNOVATION, SELMET, MOISA.



I. Vagneron/CIRAD

## Associates

**Vietnam** > Ministry of Agriculture and Rural Development; Ministry of Trade; Ministry of Science and Technology (National Office for Intellectual Property); Universities of Agriculture of Hanoi and Ho Chi Minh City; research/development institutes; decentralized State services; NGOs.

**Laos** > MMinistry of Agriculture and Forestry; NGOs.

**France and Europe** > INRA; CNRS; higher education establishments.

**International** > AFD; ACIAR; FAO; World Bank; ADB; CGIAR.

## Beneficiaries

**Local producers** will be able to develop their sales to dynamic markets and new forms of distribution.

**Consumers and distributors** have guarantees of product origin and quality.

**Policy-makers and local authorities** can improve coordination between local farming and urban markets.

**Students and professionals** will benefit from short and long training courses.

**Researchers and academic staff** are building their skills in agrifood value chain research and development.

**Scientific partners** are boosting their visibility through joint events and regular co-publications.



I. Vagneron/CIRAD

## Expertise and technical skills

- > Analyses of agrifood supply chains: multi-criteria studies (economic, social and financial), characterization of consumer demand and practices.
- > Information for market monitoring: changes in types of distribution (street sales, markets, shops, supermarkets).
- > Quality approaches; construction and impacts, study of associated intellectual property and standardization issues (origin and quality labelling systems: low external input agriculture, geographical indications, sanitary standards).
- > Analyses of territorial changes resulting from changes in agricultural production and trade.
- > Support of public policy-making, decision support (economics, law, sectorial policies, etc); feasibility studies, project management and assessment.



E. Torquebiau / CIRAD

## Some current projects

### Multi-scale Assessment of Livestock Development Pathways in Vietnam •

REVALTER, 2013-2015, Agence nationale de la recherche, France, € 530k

In Vietnam, per capita meat consumption has doubled over the past 15 years. The rapid change in livestock farming systems is being studied in three contrasting regions in Vietnam. Farms are innovating and intensifying. Territories are having to cope with new land tenure issues and environmental impacts. Supply chains are restructuring in response to new sanitary regulations and growing animal feed imports. The project has triggered discussions of possible scenarios for change with local and national decision-makers. The partners are building their skills in terms of livestock supply chain analysis in Vietnam.



E. Torquebiau / CIRAD

### Support of the development of Geographical Indications (GIs) in Vietnam •

2014-2017, Agence Française de Développement, € 0.8M

To promote well-known products of origin, many countries, particularly in Southeast Asia, protect their Geographical Indications. This project is developing this approach in Vietnam in an integrated way, linking registering of names, support of producers' organizations, and promotion of approved products. The two pilot products are Quang Tri pepper and Binh Phuoc cashew nuts.



T. de Reboul / CIRAD

### PRIGOU, Privatization of environmental governance •

PRIGOU, 2012-2015, Agence Nationale de la Recherche, France, € 430k.

This international project (Brazil, China, USA, Indonesia, Laos) is studying the growing role of non-State players, particularly multinationals and non-governmental organizations, in drafting and implementing environmental governance regulations and procedures, from a local to a global level. More specifically, it is looking at the impact of certification on organic rice production operations in Laos. It is analysing the establishment of a regional certification framework for organic products in Southeast Asia.



D. Sautier / CIRAD

### MALICA, a platform with some 30 researchers and teaching staff and six PhD students.

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CIRAD Regional Office:  
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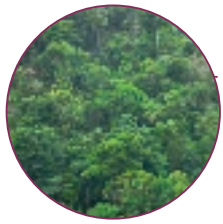


# Forests, agriculture and territorial development in Amazonia

How can we reconcile preserving the environment and supporting rural populations in this region, which plays a determining ecological role on a global scale and has such huge agricultural potential?

Amazonia is not just a forest. It is also an area in which people live and a source of jobs and income for millions of people, with implications for global agrifood and energy supply chains. Promoting sustainable forms of development goes beyond mere repression as regards deforestation.

The aim is to work with local players to build production alternatives that respect the environment and to rally each and every stakeholder in the area around this objective. Such an agrarian shift requires quality scientific outputs to which players can relate, and training.



De bas en haut: R. Poccard-Chapuis - R. Poccard-Chapuis - P. Sist / CIRAD

## Partners

**Embrapa Amazônia Oriental** >

network of research stations and technicians on pioneer fronts; Roraima centre.



**Universidade Federal do Pará (UFPA)** > Núcleo de Ciências Agrárias e Desenvolvimento Rural (NCADR): research and training laboratory for family farming in the Amazon.



**Museu Paraense Emílio Goeldi** > environmental modelling.



**Universidade do Brasil** > Sustainable development centre.

**cirad** **CIRAD** > Joint research units: ARTDEV, SELMET, INNOVATION, TETIS; Internal research units: AIDA, BioWooEB, BSEF, GREEN.



R. Poccard-Chapuis / CIRAD

## Associates

**International** > Center for International Forestry Research (CIFOR, CIAT, CGIAR).

**Bolivia** > Instituto de Investigaciones Geográficas - UMSA, La Paz

**Brazil** > Universidade Católica de Rio de Janeiro, Universidade Federal Rural da Amazônia; Museu Paraense Emílio Goeldi; EMBRAPA Amapá, Roraima and Cerrados centres; EMBRAPA remote sensing research centres; Instituto Nacional de Pesquisas Espaciais.

**Ecuador** > Instituto Nacional de Investigaciones Agropecuarias (INIAP).

**Peru** > Universidade Agraria de la Selva (UNAS); Pontificia Universidad Católica (Lima).

**France** > Ecology of the Forests of French Guiana Joint Research Unit (AgroParisTech, INRA, CIRAD, CNRS, Université des Antilles et de la Guyane), which is part of the Centre for the Study of Biodiversity in Amazonia (Laboratory of excellence); research organizations (INRA, IRD, CNRS) and higher education establishments (AgroParisTech, Montpellier SupAgro).



R. Poccard-Chapuis / CIRAD

## Beneficiaries

**Small-scale crop and livestock farmers** are being helped to implement ecologically intensive techniques and approaches.

**Grassroots institutions and decision-makers** and indeed **all the people** concerned by sustainable management of Amazonian territories will have access to analyses, assessments, support and training aimed at promoting sustainable development.

**Foresters** will be able to implement low-impact logging techniques and know more about the resources available to them.

**Students, future researchers and management staff** will benefit from appropriate training.

**Scientists** will have an inter-disciplinary working environment and openings onto other territories, disciplines and viewpoints.

# Expertise and technical skills

- Techno-economic diagnoses of farms, territories and supply chains.
- Remote sensing and mapping of land use changes.
- Advice on reduced-impact logging; assessment and management of landscape eco-efficiency.
- Methodological support for livestock farming system intensification.
- Support and co-construction of innovation processes on farms and within sociotechnical networks.
- Participatory modelling for territory management and co-construction of shared knowledge.
- Assessments and analyses of the impact of public policy and institutional dynamics aimed at fostering integrated crop farming-livestock farming-forestry operations.



## Some current projects

### Eco-efficiency and territorial development in the Brazilian Amazon • ECOTERA, ANR France, 2014-2016, € 445k

The aim is to generate knowledge and develop tools to enable grassroots players within a territory faced with global change to reconcile their aim of sustainable development with the introduction of productive, eco-efficient land use systems. The project is backed up by a group of 15 French and Brazilian researchers who have been working together in Amazonia for the past decade. Other renowned French institutions are also working on key aspects of the project: eco-efficiency (UMR ESO) and proximities (UMR SADAPT). CIFOR and various scientific networks are also associated with it.

### Mapping the degradation of Amazonian pastures • GEODEGRADE, EMBRAPA, 2012-2014, € 280k

Deforestation and extensive livestock production have led to the degradation of several tens of millions of hectares of pasture over the past 40 years. In order to implement techniques intended to restore agronomic potential and produce without further deforestation, mapping methods tailored to the ecological processes at play and the vast size of the zones concerned are to be developed. The project is also looking into several ways of assessing, mapping and monitoring pasture degradation processes within the Amazon biome. All the EMBRAPA centres in the region are involved, along with the INPE, the UFPA and CIRAD.



R. Poccard-Chapuis / CIRAD

R. Poccard-Chapuis / CIRAD

**PP AMAZONIE, a platform with some twenty researchers and teacher-researchers. Ongoing interaction between scientists, students and farmers.**

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Franco-Brazilian agreement on the Amazon biome  
<http://www.accord-biomeamazonien.org/>

CIRAD Regional Office  
<http://bresil.cirad.fr>

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a set of partners keen to work together;  
shared prospects and objectives;  
a commitment in terms of human resources,  
equipment and funding; a shared research  
topic; a specific geographical field;  
a range of skills and activities.

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# International consortium for advanced biology in Brazil

How can we share the most powerful biological research techniques with southern countries so as to cope with change?

Strategies involving high-throughput analyses of genomes and their expression, associated with functional genomics and phenotyping, are set to speed up considerably the characterization and exploitation of plant genetic resources. The scientific aim of the CIBA consortium is to explore the adaptive diversity of cultivated tropical species so as to create the varieties best suited to the prevailing biotic and abiotic constraints. To this end, it is pooling top-level knowledge, skills, scientific resources and plant material collections.

## Partners



CIBA is the fruit of an agreement between **Agropolis International (France)** and **Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA, Brazil)**. The CIBA management is done by an Operational Coordination Team (OCT), steered by a Scientific and Technical Committee (STC).

### BRAZIL >



**Embrapa** > Genetic resources and biotechnologies (CENARGEN), cotton and rice (CNPQ, CNPAF), cassava and fruits (CNPMP), Cerrados (CPAC), Eastern Amazon (CPATU).



**Federal University of Lavras (UFLA)**.



**State University of Santa Cruz (UESC)**.



**Luiz de Queiroz Agricultural College** University of São Paulo (ESALQ/USP)



**Cocoa agricultural research centre (CEPLAC)**.



**Paraná Institute of Agromony (IAPAR)**.

### FRANCE >



**Agropolis international**, primarily including:



**IRD** > Joint research unit: RPB



**Inra** > Joint research unit: AGAP



**CIRAD** > Joint research units: AGAP and RPB; Internal research unit: Pests and Diseases, AIDA and BioWooEB.

## Funding

**France** > Agropolis Foundation; French Embassy in Brazil; CIRAD; Comité français d'évaluation de la coopération universitaire et scientifique avec le Brésil (COFECUB).

**Brazil** > EMBRAPA; Higher Education and Training Coordination (CAPES); National scientific and technical development council (CNPq); Bahia State research support foundation (FAPESB);

São Paulo State research support foundation (FAPESP); Coffee R&D Consortium.

## Associates

**Africa** > Research institutes: IRAD (Cameroon), CRDPI (Congo), CERAAS (Senegal), University of Antananarivo, ESSA Forêt (Madagascar).

**Latin America** > CATIE (Costa Rica), IBONE (Argentina), Brazilian States and public universities.

**France** > Joint research units: AMAP, Eco&Sols; INRA (PIAF JRU); LRSV/UPS-CNRS, Toulouse.

## Beneficiaries

**Brazilian farmers** (rice, coffee, cocoa, etc) have new varieties, founded on broader genetic bases.

**Brazilian, European and African research organizations** can produce and test plant material and working populations (coffee, cotton, sorghum, rubber tree, etc).

**Students, future management staff and researchers** in the consortium benefit from exchanges and knowledge sharing.

**Collaboration between Europe, South America and Africa is easier**, in terms of both scientific projects and certificate and non-certificate training.

## Expertise and technical skills

- > Pre-breeding: identification of worthwhile characters, genome segments or genes in existing planting material; transfer of populations suitable for use in crop improvement to create varieties tailored to specific requirements.
- > Development of markers, characterization of populations, genetic mapping.
- > Structural genomics, comparative genomics, functional genomics, metabolomics, genotyping, phenotyping.
- > Gene validation, genetic transformation, DNA, RNAi and RT-qPCR analyses.
- > Study of specific crops: banana, cocoa, coffee, citrus, cotton, eucalyptus, oil palm, rice, sorghum, rubber tree, etc.
- > Identification of agronomic traits of interest related to biotic and abiotic constraints.
- > Organization of training courses (students, researchers).



P. Marraccini/CIRAD

## Some current projects

In 2015, more than 30 projects are under way, co-funded by French and Brazilian donors.

### Fostering exchanges and synergies •

CAPES, Brazil; Agropolis Fondation, France

Coffee genetic diversity and drought tolerance (2013-2014); association for the study of the diversity of Ethiopian *Coffea arabica* germplasm (2014-2015); cocoa genomic breeding for productivity and resistance (2014-2016); influence of the genotype-environment interaction on mandarin quality (2013-2016); impact of water constraints and mineral flux on genome expression and wood formation (2013-2016).



UMR AGAP



G. Chaix/CIRAD

### Developing a research platform to improve tropical tree crop species • CNPq, Brazil

Strengthening of the "omics" platform at the University of Santa Cruz (UESC) for tree crop protection (2013-2016); exploiting genotype-environment interactions to improve citrus fruit quality (2013-2015); effects of water stress and potassium and sodium fertilization on growth and wood formation and quality in *Eucalyptus grandis* (2013-2014).

### Strengthening pest resistance in cocoa and cupuaçu •

CAPES, EMBRAPA, FAPESB, Brazil

Genomics of the interactions between hosts of the genus *Theobroma* and *Moniliophthora perniciosa*, which causes witches' broom disease: functional studies with a view to improving cocoa and cupuaçu (*Theobroma grandiflorum*) (2011-2014); development of populations for cocoa improvement as regards frosty pod rot (2014-2016); selection based on large-scale genotyping of cocoa trees that are sources of resistance to witches' broom and black pod (2014-2016).



D. Clément/CIRAD

### CIBA, International Consortium for Advanced Biology

In 2015:

7 CIRAD researchers in Brazil, 15 in Montpellier, numerous Brazilian researchers plus teaching staff, 27 students (Masters or PhD), 71 papers presented at symposiums, 20 articles in international scientific journals.

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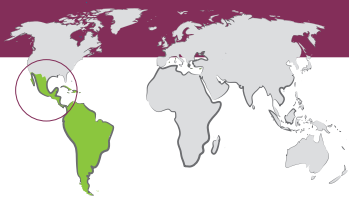
[www.ciba-network.org](http://www.ciba-network.org)  
CIBA organizes a thematic workshop each year: CIBA 2013: <http://www.ciba2013.net/>  
CIBA 2012: <http://www.ciba2012.com/>  
CIRAD Regional Office  
<http://bresil.cirad.fr/>

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# Agroforestry Systems in Central America

How can coffee and cocoa tree management within agroforestry systems boost the competitiveness of family farms?

In Central America, 90% of coffee- and cocoa-based agroforestry systems are in the hands of smallholders. These activities make a substantial contribution to

development in the poorest countries (Honduras and Nicaragua).

Moreover, natural resources and biodiversity are two of the region's fundamental assets. Research is working to quantify the production of value and environmental services by such systems so as to develop, along with farmers and other players, competitive, varied and sustainable management strategies.

## Partners



**Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)** > international university for development through research (13 Latin American countries), agroforestry trials (Costa Rica, Nicaragua).



**PROMECAFE** > regional cooperation between coffee research institutes.



**INCAE** > private management school (Costa Rica, Nicaragua).



**Bioversity International** > CGIAR research centre working on genetic resource conservation and banana cropping systems.



**ICRAF** > CGIAR agroforestry research centre.



**CABI** > centre for information and expertise on agriculture and the environment.



**CIRAD** > Joint Research Units: SYSTEM, Eco&Sols, INNOVATION. Internal Research Units: ARENA, Controlling Pests and Diseases in Tree Crops, BioWooEB, GREEN, Banana, Plantain and Pineapple Cropping Systems.



B. Rapidel/CIRAD

## Associates

**Central America** > national universities, research centres, authorities, coffee, cocoa and banana producers' cooperatives and associations; certified platforms for the measurement and assessment of ecosystem services on family farms; the only network of its kind in the world for studies of environmental protection incentive policies.

**Africa** > a "twin" structure in Cameroon (Agroforestry Systems in Africa SPP).

**Global** > the scientific community: the agroforestry and cropping systems concerned; Universities of Bangor and Cambridge (UK), Idaho, Hawaii, Davis (USA), Toronto (Canada), Wageningen (Netherlands), Montpellier SupAgro.



Cafedirect

## Beneficiaries

**Coffee, cocoa and banana smallholders** will be able to boost the profitability of their farms and diversify their sources of income, while helping to preserve biodiversity.

**Firms in Central America** will be better informed of the benefits they could draw from agroforestry systems. In particular, hydroelectric dam managers would have more tools for protecting watersheds.

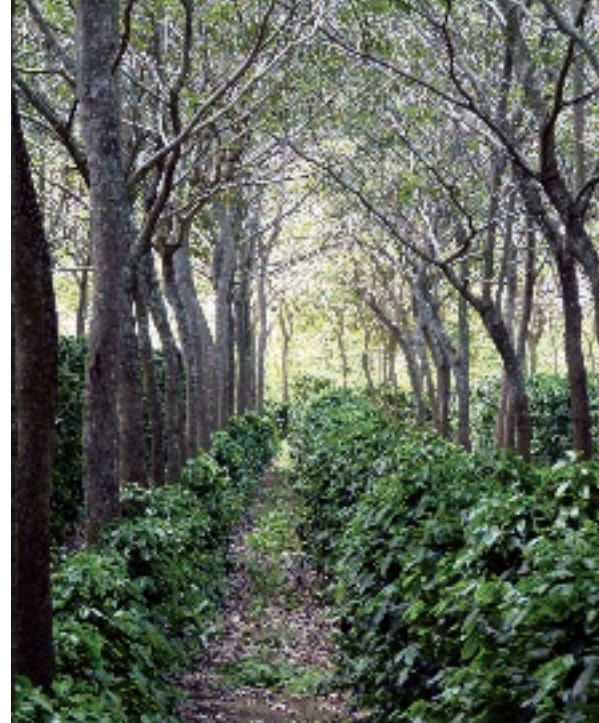
**Stakeholders in agroforestry systems in Africa** will also benefit from the knowledge acquired.

**Politicians** will have assessments and analyses to help optimize public action in favour of the environment and development.

**Students, researchers, and current and future management staff** will be able to acquire new skills and publish their work in international journals.

## Expertise and technical skills

- > Carbon balance for coffee- and cocoa-based agroforestry systems.
- > Introduction of indications of origin or terroir.
- > Development of sustainable disease resistance management strategies.
- > Analysis and design of postharvest processing systems: from pod to merchantable cocoa and from coffee cherries to green and roasted beans.
- > Soil diagnoses on cocoa farms (a tool that enables fertilizer schedule recommendations).
- > Varietal improvement and breeding.
- > Product traceability.
- > Training course: "Devenez expert en cacao" (become a cocoa expert).
- > On-line training course in the sociological approach to agroforestry systems.



B. Rapidel/CIRAD

## Some current projects

**Knowledge sharing in support of climate change adaptation for local development •**  
EcoAdapt, 2012-2016, European Commission, € 2M, Chile, Argentina, Bolivia

The aim is to build collective natural resource management capacity, notably for water, by involving local communities, civil society organizations, policy-makers and researchers.



O. Deheuvels/CIRAD

**Analyses and models to quantify the ecosystem services rendered by roots •**  
ECOSFIX, 2011-2014, ANR-France, € 1M

The aim is to produce a decision support tool and directives. The analysis of root traits and of their role in carbon sequestration and fixation in the soil will enable the development of digital models that integrate root-soil relations and make it possible to suggest criteria for making choices based on site effects and management constraints.



B. Rapidel/CIRAD

**Scenarios with all the stakeholders to adapt tree crop or agroforest plantings to climate change •** MACACC, 2014-2017, ANR-France, € 1M

The aim is to mobilize economists, climatologists, eco-physiologists, modellers, professional organizations and a large group of producers (more than 300) to work on the issue of how to adapt their tree crop plantations to global change. The case studies conducted cover a wide range of economic, ecological and climatic situations. Realistic adaptation scenarios will be drafted with the stakeholders for rapid implementation.



B. Rapidel/CIRAD

**AFS-PC SPP,  
a platform of some  
sixty researchers,  
teaching staff members  
and Masters and PhD students**

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# Public policy and rural development in Latin America

How can we help the rural world and decision-makers revise their position using different rural development tools?

The PP-AL network studies the drafting and implementation of agricultural, environmental and rural development policies with a view to understanding their mechanisms and effects, particularly in terms of rural change.

## Partners

**Argentina** > INTA; CONYCET; Univ. Nac. de la Plata; UBA; Univ. Nac. De Patagonia Austral.

**Brazil** > UFRRJ; UnB; USP; UFRGS; UFPA; UFSC; UFPE; UFCG; EMBRAPA; etc.

**Costa Rica** > CATIE; IICA; UNA-CINPE; FLACSO, MAG.

**Chili** > CEPAL; Univ. de Chile; FAO/LAC; Univ. Cat Valparaíso; INDAP; RIMISP.

**Cuba** > Univ. of Havana.

**Ecuador** > FLACSO Quito; Ministerio de Agricultura y Ganadería/INIAP; AVSF.

**Mexico** > UNAM; COLMEX; CEDRSSA; Chapingo Univ.; Univ. Iberoamericana; UAEM.

**Nicaragua** > UCA; NITLAPAN.

**Peru** > UARM; GRADE/SEPIA; CIPCA.

**Uruguay** > UDELAR; IPA; INIA; PROCISUR.

**France, Europe and North America** > CIRAD (Internal research units: ART-DEV, BSEF GREEN, Joint research units: INNOVATION, MOISA, SELMET, TETIS); INRA; IRD; Agroparistech; Wageningen University; University of Oxford; Innsbruck University; Universitat de Barcelona; Univ. Nova de Lisboa; etc.

**International** > International organizations and inter-American organizations: CEPAL; FAO; IICA; UNDP; FLACSO.



E. Sabourin/CIRAD

## Beneficiaries

Many **decision-makers** obtain knowledge, tools and methods that serve to involve stakeholders and inform their decisions. They participate in seminars organized by the PP-AL network.

**Regional rural producers' organizations and national farmers' associations** associated with the PP-AL network's operations, develop new management methods, and participate in the network's workshops. They also have access to results via member laboratories and regional and national research centres.

**Scientists** can share resources, methods and results via seminars, symposia and workshops. They boost their visibility through joint-publications in international journals.

**Students** can build their skills through training, internships and PhD supervision.



F. Boucher/CIRAD

# Expertise and technical skills

- Support of agricultural, environmental and rural development policy-making and alleviation of poverty and inequality.
- Training of decision-makers and top-level civil servants in public policy administration and land use planning.
- Support of and capacity-building operations for producers' organizations and local communities.
- Analyses of changes in the role of the State and public-private partnerships.
- Analyses of the globalization of public policy: the role of mediators and of aid.
- Pluralist assessments of public policy instruments.



B. Rapidel/CIRAD

## Some current projects

**Integrating valuations, markets and policies for biodiversity and ecosystem services • INVALUABLE** (Mexico, Costa Rica, Guatemala), 2012-2015, EU BIODIVERSA ERANET, € 2M

What public policies and what legal frameworks can promote the development of PES? Public policy has a role to play in ensuring that different ecosystem values are pinpointed and taken into account. Economic valuations are used to draft regulations covering compensation mechanisms.



B. Locatelli/CIRAD

**Ecosystem-based strategies and innovations in water governance networks for adaptation to climate change in Latino-American landscapes • ECOADAPT**, 2012-2015, EU FP7 approx. € 1.9M

An interdisciplinary research-action project in support of the collective capacity of organizations and local communities to manage hydrological services, a source of tension and social conflict in the community forests of Argentina, Bolivia and Chile in the face of global and climate change.



B. Locatelli/CIRAD

**The struggles for "blue gold": from grassroots mobilizations for water to the internationalization of environmental policies • Bluegrass**, 2014-2016, ANR, € 0.4M

This project is studying conflict around water, through a multi-level approach to water governance, from grassroots to global, in the USA and four Latin American countries: Bolivia, Brazil, Colombia and Mexico.



B. Locatelli/CIRAD

**Territories, poverty and public policy • 2013-2016, CAPES-COFECUB**, € 0.3M

The main aim of the project is to build and share knowledge on the processes by which poverty becomes territorialized and of operations to reduce that territorialization in France and Brazil.



F. Boucher/CIRAD

**Short circuits in Latin America • FONTAGRO**, 2014-2016, IDB, US\$ 810 000

This project links agricultural research centres and regional farmers' organizations, to identify innovations within production and marketing systems for family farms. It is particularly interested in short circuits and contracts between family farms and industry, in six countries (Argentina, Brazil, Chile, Paraguay, Peru, Uruguay).



B. Locatelli/CIRAD

## Working together for tomorrow's agriculture

**PP-AL: Public policy and rural development in Latin America**

**A multi-disciplinary network with 120 researchers and teaching staff members and 30 Masters and PhD students**

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<http://www.pp-al.org>

CIRAD Regional Office  
<http://bresil.cirad.fr/>

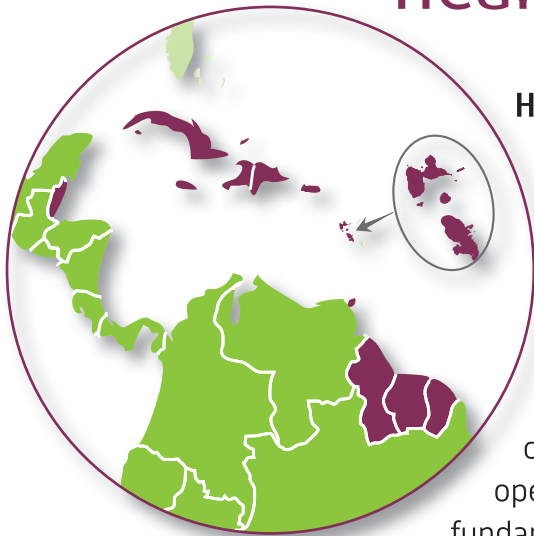
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# CaribVET, Caribbean animal health network



## How can fundamental research help strengthen animal disease surveillance and control networks?

**B**iodiversity hotspots are often associated with the emergence of new pathogens. The Caribbean, which includes territories with highly contrasting ecological and socioeconomic situations, is one example. Research can help improve surveillance and control of such diseases by combining the most fundamental studies with the most operational applications. This integrative approach involves fundamental research, and also decision-makers, managers and surveillance staff. The CaribVET regional network is one such approach.

### Partners



**Ministries and veterinary services in the 33 countries and territories in the Caribbean<sup>1</sup>**

**Universities >** University of Guyana; University of the West Indies.

**Research centres >** Centro Nacional de Sanidad Agropecuaria (CENSA, Cuba); CIRAD, Emerging and Exotic Animal Disease Control (UMR CMAEE), Guadeloupe.

**Regional organizations >** Caribbean Community (Caricom); Pan-American Health Organization (PAHO); United States Department of Agriculture, International Service (USDA-APHIS-IS).

**International organizations >** Food and Agriculture Organization of the United Nations (FAO); World Organization for Animal Health (OIE); Inter-American Institute for Cooperation on Agriculture (IICA-CGIAR).



CIRAD

### Associates

**Europe >** Centre de Recerca en Sanitat Animal (CRESA, Spain), Instituto de Biologia Experimental Tecnológica (IBET, Portugal), Instituto de Tecnologia Química et Biológica (ITQB, Portugal), Agriculture and Veterinary Information and Analysis (AviaGIS, Belgium), Ecole des hautes études de santé publique (EHESP, France), INRA (France).

**French overseas regions >** INRA, Institut Pasteur, Centre Hospitalier Universitaire, CHU, Agence Régionale de Santé (ARS), Université Antilles-Guyane (UAG).

**International >** CIRAD, in Guadeloupe, is the world reference laboratory for heartwater. It is an OIE collaborating centre for the diagnosis, epidemiology and control of tropical animal diseases



CIRAD

### Beneficiaries

**Policy-makers and veterinary services** are able to build their surveillance and diagnosis capacity thanks to a network of laboratories, methods and tools developed by CaribVET. The reactivity and cost:benefit ratio of installations have been improved.

**Livestock farmers** benefit from the latest knowledge generated by research and from recommendations.

**Each and every animal health stakeholder in the Caribbean** has access to the information and tools produced by CaribVET.

**Students, future management staff and researchers** can build their scientific and technical knowledge in the fields of epidemiology and diagnosis, through exchanges and training.

1. Anguilla, Antigua, Aruba, Bahamas, Barbados, Belize, Bermuda, Bonaire, British Virgin Islands, Cayman Islands, Cuba, Curaçao, Dominican Republic, French Guiana, Grenada, Guad yana, Haiti, Jamaica, Martinique, Montserrat, Nevis, Puerto Rico, St. Eustatius, St. Kitts, St. Marteen, St. Vincent and the Grenadines, St. Lucia, Surinam, Trinidad and Tobago, Turks and Caicos Islands, US Virgin Islands

## Expertise and technical skills

- Diagnosis and surveillance of priority animal and zoonotic diseases: avian influenza and Newcastle disease, classical swine fever, ticks (*Amblyomma variegatum*, *Rhipicephalus* [*Boophilus*] *microplus*) and tick-borne diseases (heartwater, anaplasmosis, babesiosis); veterinary public health (rabies, salmonella and leptospirosis) and emerging diseases (porcine epidemic diarrhoea).
- Epidemiological surveillance: databases, guides and protocols, network assessment, regional surveys, etc.
- Tools & database development: risk assessment, priority diseases, network assessment tools, expertise databases.
- Training centres: epidemiology, laboratory diagnoses, quality assurance, simulation exercises (sample shipment, emergency preparedness), biosecurity.
- OIE reference laboratory for heartwater, OIE collaborating centre for the diagnosis, epidemiology and control of tropical animal diseases (CIRAD) and OIE collaborating centre for the reduction of zoonotic risks following disasters (CENSA).
- DGAL approved laboratory for serological diagnosis of West Nile (WN) in equines and real-time PCR diagnosis of avian influenza, COFRAC accreditation (standard 17025) for diagnosis of heartwater, AI and WN.



T. Lefrançois/CIRAD

## Some current projects

### Building health research capacity in Guadeloupe • Epigenesis, European Commission, FP7, 2013-2016, € 3.5M

By building capacity for research and transmission of knowledge relating to "one health" (animal and human), the project will help increase diseases prediction, surveillance and control capacity in the Caribbean. The eventual aim is to establish a Caribbean centre of excellence on vector-borne and emerging diseases.

### One Health, One Caribbean, One Love • ACP project, Science and Technology, UWI, 2014-2016, € 1M

The aim is to promote a "One Health" approach to zoonotic and food-borne disease surveillance, diagnosis and response. Expected results are to improve intersectoral collaboration between medical, veterinary, environmental and wildlife professionals, increase capacity to identify and respond to transboundary animal and zoonotic diseases and increase laboratory capability to diagnose foreign and endemic animal and zoonotic diseases.



P. Fournier/CIRAD



P. Fournier/CIRAD

### Cattle tick resistance to acaricides, tick-borne disease surveillance and control • ResisT, 2013-2015, Fonds de Coopération Régionale, € 214k

Cattle ticks (*Rhipicephalus* [*Boophilus*] *microplus*) are widespread throughout the tropical and inter-tropical zones. They can transmit two serious diseases to cattle (babesiosis and anaplasmosis), and are known to develop resistance to acaricides. The project has allowed itself two years to take stock of the situation as regards resistance to acaricides in the Caribbean and establish a new in vitro diagnostic test so as to identify this problem rapidly, given that it is of concern for farmers, veterinarians and researchers. The project also aims to develop strategies to improve surveillance and control of TBDs in ruminants with a view to slowing down the development of resistance.



CIRAD

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Regional Office  
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# Irrigated Systems in North Africa

A network to support local irrigated systems and contribute to global debate on irrigation.

North Africa has a shortfall in terms of agricultural production and its food security is fragile. It is also one of the places where climate change is the most sensitive, with a direct impact on water resource availability. The problem is that agricultural production directly depends on irrigation, hence on water resources. Moreover, North Africa is currently in the throes of political and economic change. The SIRMA platform is analysing irrigated systems against this backdrop of environmental and societal change, which is both particularly interesting and fraught with issues for the region's economic future.



Photos: SIRMA

## Partners

-  **Ecole Nationale d'Agriculture de Meknès (ENA Meknes)**
-  **Ecole Nationale Supérieure Agronomique d'Alger (ENSA Alger)**
-  **Institut Agronomique et Vétérinaire Hassan II, Rabat (IAV Hassan II)**
-  **Institut National Agronomique de Tunis (INAT)**
-  **Institut National de Recherche en Génie Rural, Eau et Forêts, Tunis (INRGREF)**
-  **Le Centre Universitaire Khemis Miliana**  
**Centre Universitaire Khemis Miliana Centre de Recherche Scientifique et Technique sur les Régions Arides/ Mohamed Khider University, Biskra**
-  **Institut des sciences et industries du vivant et de l'environnement (AgroParisTech)**
-  **Centre International de Hautes Etudes Agronomiques Méditerranéennes - Institut Agronomique Méditerranéen de Montpellier (CIEHAM-IAMM)**
-  **Institut de recherche en sciences et technologies pour l'environnement et l'agriculture, Montpellier (IRSTEA)**
-  **Institut de Recherche pour le Développement, Montpellier (IRD)**
-  **Centre international d'études supérieures en sciences agronomiques (Montpellier SupAgro)**
-  **French Agricultural Research Centre for International Development (CIRAD).**

## Associates



H. Quarouch

- Morocco >** State services concerned with agricultural water; development offices; professional agricultural organizations, NGOs.
- Algeria >** State services concerned with agricultural water; NGOs.
- Tunisia >** State services concerned with agricultural water; Regional agricultural development commissariats.
- France and Europe >** INRA; Universities (Paris, Aix en Provence, Montpellier, Wageningen, Madrid, etc).
- International >** AFC; CGIAR.

## Beneficiaries

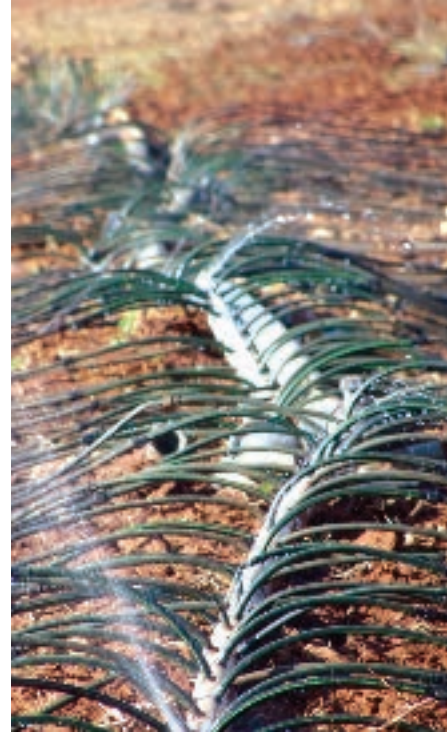
- Local producers** are improving agricultural production and water management.
- Irrigation associations** are building their expertise in collective irrigation management and consultation with users.
- Politicians, irrigation scheme managers and local authorities** are improving their management of natural resources.
- Students and professionals** are receiving short- and long-term training (initial training, refresher courses, research training).
- Researchers and teaching staff** are building their research and development skills.
- Scientific partners** are boosting their visibility through regular co-publications.



M. Kuper/CIRAD

# Expertise and technical skills

- > Sustainability of irrigated agriculture models based on surface water and groundwater.
- > Consideration of environmental constraints in managing farms and irrigation schemes.
- > Building stakeholder capacity, support of professional organizations and public policy.
- > Dissemination and adoption of technical innovations in support of local initiatives.
- > Multi-scale studies of innovation processes (farms, supply chains and territories).
- > Design of individual and group training courses (advice, participatory approaches, role-play, etc).
- > Study of informal governance mechanisms on various scales (scheme, territory, region, national, etc)
- > Multi-criteria innovation assessment methods and impact studies (indicators and methods).
- > Environmental assessments including immaterial factors such as knowledge and know-how.
- > Support for publication (writing workshops, publication in international journals).
- > Crossed training and apprenticeships for young engineers and researchers from North Africa (30 PhD students trained or being trained).
- > Identification, feasibility studies, management and assessment of R&D projects (European Commission, ANR, AFD, etc).



J.Y. Jamin/CIRAD

## Some current projects

### Groundwater governance in North Africa • Groundwater Arena, 2012-2015, ANR, € 0.8M

In response to environmental, economic and social change, the project is analysing the vulnerability and adaptability of irrigated farming systems that use groundwater. Intensive groundwater use has enabled the development of a dynamic agricultural economy, but there have been numerous environmental consequences that are making farming systems in the region vulnerable.



H. Quarouch



S. Mariet/CIRAD

### Programme of pilot operations in support of agricultural development groups within irrigation systems • PAP-AGIR, 2011-2015, AFD, € 0.6M

This project is fuelling the debate on support of agricultural development groups (ADGs) as regards irrigation, to ensure effective long-term management of public irrigation schemes. It is providing information that should serve to improve community management of water supply systems.

### European Union and African Union cooperative research to increase food production in irrigated farming systems in Africa • Eau4Food, 2012-2015, European Commission/ DG for Research/ FP7, € 0.4M

The project is supporting innovation processes in the irrigated farming sector, within the framework of participatory approaches involving farmers, development managers, research centres and technical institutes. It is working to boost irrigated food production which limiting the environmental impact.



D. Rolliv/IRSTEA



E. Baudran/AFD

### Moyen-Sebou-Inaouen Aval • PMSIA, 2010-2014, AFD € 0.1M

The aim of the project is to optimize development of the zone through agricultural development. It is managed by the Union des Fédérations des AUEA du Moyen Sebou-Inaouen Aval, and is working for economic development in the region and supporting the development of this irrigation scheme.

## SIRMA, a multi-disciplinary network with 60 researchers and teaching staff members

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### For further information

Network website:  
<http://www.rcp-sirma.org>  
CIRAD Regional Office:  
<http://mediterranee.cirad.fr>

A platform is...  
a set of partners keen to work together;  
shared prospects and objectives;  
a commitment in terms of human resources,  
equipment and funding; a shared research  
topic; a specific geographical field;  
a range of skills and activities.

[www.cirad.fr](http://www.cirad.fr)

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