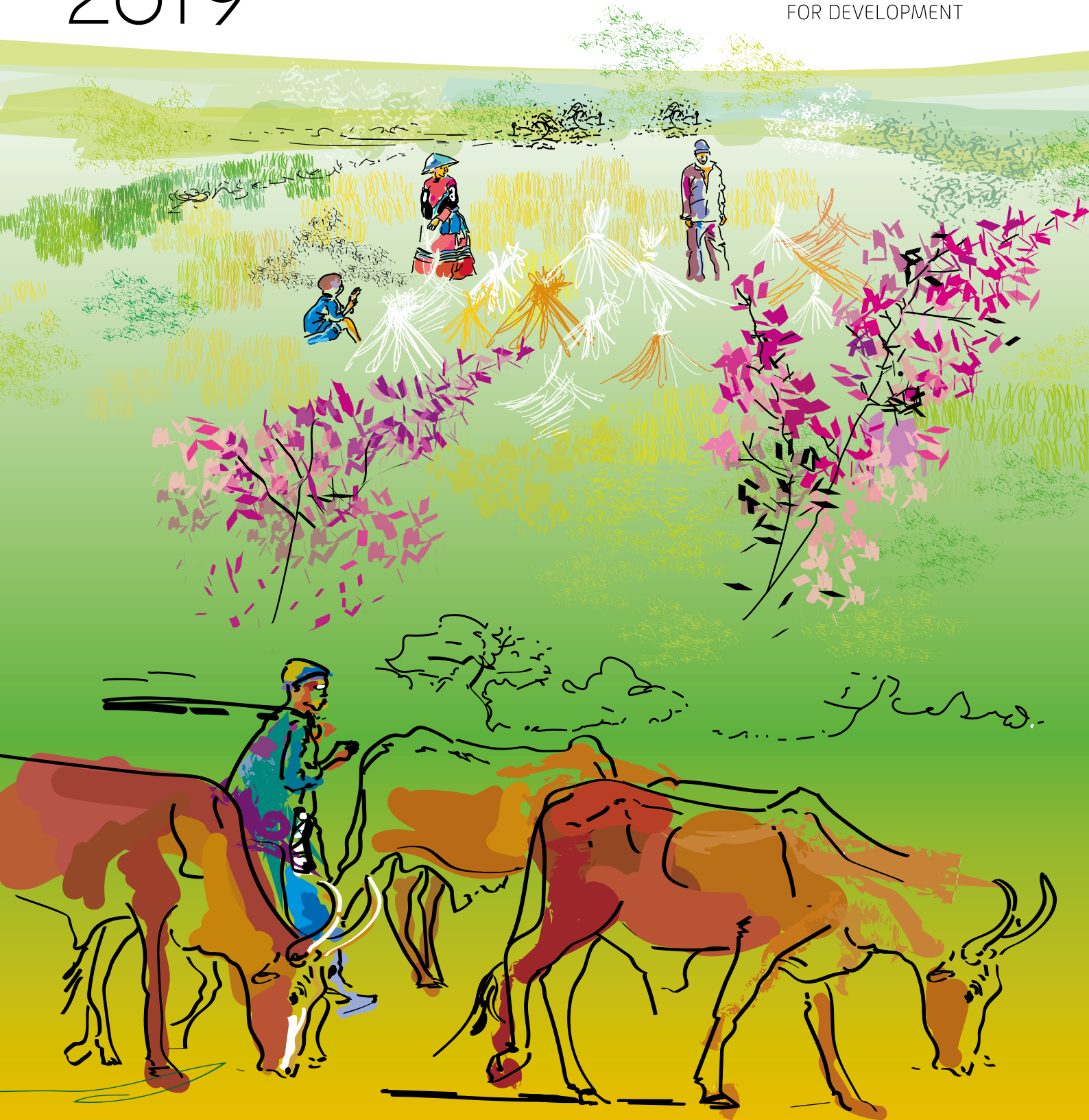


# Activities Report 2019



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CIRAD is the French agricultural research and international cooperation organization working for the sustainable development of tropical and Mediterranean regions.

Along with its partners, it is convinced that agriculture has a central role in the major transitions required to guarantee a sustainable future for every country in the global South. Generating and sharing new knowledge, contributing to innovation processes and building the capacity and skills of stakeholders in those countries to support their sustainable development are the drivers of its operations. In particular, its activities centre on issues such as biodiversity, the agroecological transition, climate change, health [of plants, animals and ecosystems], the development of rural territories, and food systems.

CIRAD works in some fifty countries on every continent, thanks to the expertise of its 1650 staff members, including 800 researchers, backed by a global network of partners.

**Budget of  
200 million euros**

**Leading research  
operator in the  
French overseas regions**

## Key thematic fields

CIRAD centres its operations on six key thematic fields. Each of those fields covers a major research issue shared with our partners in the global South, to which CIRAD has opted to commit collectively, in an integrative, multi-disciplinary manner, with the aim of renewing, diversifying and extending its scientific outputs and partnerships.



Biodiversity



Integrated health approach



Agroecological transitions



Territories



Food systems



Climate change

# EDITORIAL

Michel Eddi,  
CIRAD President  
Managing  
Director



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## BUILDING AN INCLUSIVE FUTURE TO MEET CHALLENGES WHILE MITIGATING THREATS

In France, Europe and the rest of the world, we are living in a time when the future no longer resembles a promise of possible progress. The climate crisis and the urgency of the ecological transition remind us that we now live in a world in which disasters can strike anywhere. At a time when the fear of others and the tendency to withdraw are increasing, we need to reinvent ways to work together to produce responses and collective resources, so as to build an inclusive future and mitigate threats. We must not lose hope, as awareness is growing everywhere, and in particular among the younger generation, of the urgent need to act in order to avoid the worst. Coalitions of actors are mobilizing, each at their own level, to invent this new pathway towards a desirable future. Moreover, the new European Commission has just made strong and clear commitments to this effect with its "European Green Deal".

## MORE THAN EVER, SCIENCE HAS A ROLE TO PLAY

Faced with these challenges, we clearly see that science, through its outputs, has a crucial role to play and a major responsibility in supporting this shift from words to deeds. We do not have ready-made solutions in our laboratories that would solve all of the problems as if by magic. But faced with the complexity and diversity of the issues at stake, science is capable of pinpointing specific situations to be addressed. In conjunction with the actors concerned, it should also provide political and economic decision-makers with potential solutions to ensure they agree to engage in these approaches aimed at radically transforming our societies.

## CIRAD'S RECOGNIZED SOCIAL UTILITY

At CIRAD, we have for many years worked in partnership, following a participatory, socially and politically driven scientific approach, in which economic and social actors are the source of the issues we address and the target of the solutions we seek to provide, based on the co-construction of projects aimed from the outset at fostering

impact for development. The research areas central to our Strategic Vision and to our Scientific and Partnership Strategy Objectives are all now at the top of the policy agenda and international negotiations.

## A SCALE CHANGE IN TERMS OF PLANNING

The end of 2019 was marked by the signature of the first wave of ten DeSIRA\* projects (five of which are coordinated by CIRAD), three AFD projects (two of which are also coordinated by CIRAD), and one French Ministry of the Overseas Regions project, "Sustainable territories" (French West Indies and Réunion). All parts of the world are covered, with a high concentration sought by CIRAD and AFD in the Sahel, contributing to the implementation of the September 2018 Ouagadougou Declaration. These 14 projects will generate 60 million euros of funding, with half for CIRAD and the other half for our partners in the global South. This scale change in our contractual activity has been possible thanks in particular to the success of the Research Impact and Marketing Service (DIMS), created in January 2019.

## 2020 WILL BE THE YEAR OF EMPLOYMENT AND SOCIAL RESPONSIBILITY

At the same time, our Contractual Objectives for the period 2019-2023 were unanimously adopted by the Board, further evidence of the collective strength of CIRAD's model. They confirm our strategic ambition, with an increase in geographical mobility in the global South, and our commitment to skills training, strongly supported by the MUSE I-Site\*\* and the members of Agreenium. To meet these expectations, it is important that we have the necessary expertise in-house. This is why, in 2019, we recruited 80 new staff members, and we will continue on this path in 2020. Finally, at the heart of our "social contract", there is also our determination to commit even more to our social responsibility. 2020 will be the year we succeed in federating all the initiatives by various groups within the framework of an action plan that will enhance everything the institution has already achieved for sustainable development over the last few years, through leading by example. Once again, exemplarity must be our collective hallmark. ■

\*DeSIRA: *Development Smart Innovation through Research in Agriculture*. An initiative launched and financed by the European Union

\*\* MUSE: Montpellier University of Excellence

# Social responsibility at CIRAD

**S**ustainable development is central to CIRAD's work and to its mandate as a public targeted research establishment. To address the urgency of development challenges, CIRAD argues that the social and environmental dimensions of development should be prioritized over its economic dimension in order to ensure the survival of humankind and the planet.

CIRAD aligns its commitment to social responsibility with principles relating to respect of human rights,

international labour standards, the environment and the fight against corruption. Its mandate and its practices are also guided by the 17 Sustainable Development Goals, the Paris Climate Agreement and the 2030 Agenda for France.

This is why CIRAD strives to be exemplary in its own practices and their impacts, in accordance with its mandate.

## A common thread: ethics, professional conduct and scientific integrity

The Committee on Ethics examines the ethical questions raised by research activities and the research process, particularly those that concern the relationships between science and society.

In 2019, it issued a statement on genetic modification of animals in the light of modern genome editing techniques.

The Ethics and Research Integrity Office supports the establishment and its staff in terms of ethics and scientific integrity and implements the charter of ethics (awareness, advice and handling of situations).

It was rapidly mobilized from its inception and the requests made to it more than tripled between 2018 and 2019 (58 requests over the two years).

Since these ethical and scientific integrity issues are a shared concern, a participatory method (Participatory Action Research) is gradually being deployed. In 2019, actions were conducted in Guadeloupe and Martinique, involving universities and research establishments (graduate schools, regional ethics organizations), in collaboration with CNRS, SAS2 and the University of Ottawa.

CIRAD,  
A COMMITTED PUBLIC  
ESTABLISHMENT...  
A FEW DATES

- 2007 > Creation of the INRA-CIRAD Committee on Ethics, joined by IFREMER (2016) and IRD (2019).
- 2009 > Signature of an agreement on integrating and keeping people with disabilities in the workplace, between General Management and social partners.
- 2014 > Signature of the French sustainable development charter for public establishments and enterprises and the national charter on ethics in research professions.

## Towards an inclusive CIRAD



### Fostering gender equality in the workplace and consolidating CIRAD's gender policy

The year 2019 saw an acceleration on this subject. First, CIRAD adopted an ambitious strategy on gender equality in the workplace, focusing on three areas: integrating equality in the workplace into the institution's governance and internal operations; integrating the gender dimension into its scientific and partnership strategy; and promoting CIRAD's action on issues relating to gender equality in the workplace. Second, CIRAD is coordinating the EU Horizon 2020 "Gender-SMART" project. In this first year, CIRAD and its eight European partners conducted a review, and drafted and implemented an initial "gender" action plan.

<https://bit.ly/2WSEElk>

### Integrating and keeping people with disabilities in the workplace

The agreement signed in 2009, and revised every three years, provides for the implementation of actions in five key areas:

- Employing people with disabilities.
- Supporting employees faced with a disability.
- Tapping into the expertise of the sheltered employment sector.
- Making premises accessible.
- Communicating and raising awareness for a lasting change in mentalities.

The disability officer and the disability correspondents in the French overseas regions guide these actions with the support of a multidisciplinary network, both internally (management, human resources, occupational psychologist, social worker, health coordinator, employee representative bodies) and externally (occupational physician, Cap Emploi, Agefiph).

The results speak for themselves: since 2014, CIRAD has fulfilled its obligations and even exceeded the mandatory target of 6% of employees with disabilities.



- 2016 > Drafting of its sustainable development and social responsibility policy.
- 2017 > Signature of an agreement on equality in the workplace and deployment of CIRAD's charter of ethics adapted to research for development partnerships as well as to its collaborations with the private sector.
- 2018 > Membership of the "Référénts Handicap Occitanie" (Occitanie disability coordinators) network and creation of the Ethics and Research Integrity Office and the Ethics Monitoring Committee.

- 2019 > Award of the "Refuge Ligue de protection des Oiseaux – LPO" (Bird protection league refuge) label for the Lavalette and Baillarguet sites in Montpellier.

Finally, CIRAD is engaged, along with the Conférence des Grandes Ecoles (Conference of leading French universities) and the Conférence des Présidents d'Université (Conference of university presidents), in revising the sustainable development label for higher education institutions so as to open it up to research organizations.

CIRAD is a partner of the Handijob forum, and a member of the inter EPIC-EPST network on quality of work life (created in 2017).

## An environmental process that is gaining momentum

CIRAD has launched processes to reduce the direct and indirect environmental impacts of its activities with a view to addressing climate challenges, preventing pollution and preserving natural resources.

### A priority: sustainable energy consumption and waste management

The action plan on environmental responsibility sets out the priority objectives of the establishment's policy on sustainable development and social responsibility: the sustainable management of fluid consumption and the responsible management of waste. These issues are fully integrated into the multi-year real estate strategy plan (SPSI-2 2020-2024),

which provides for the complete renovation of its oldest buildings and an eco-responsible new building plan.

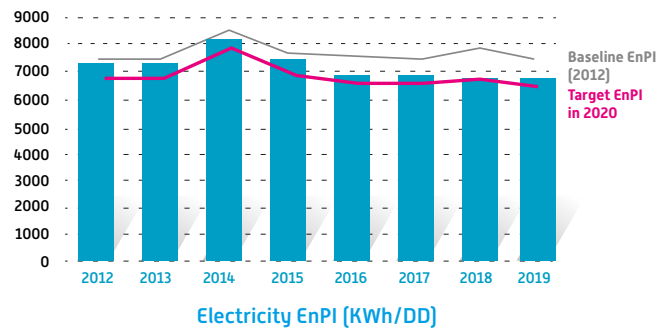
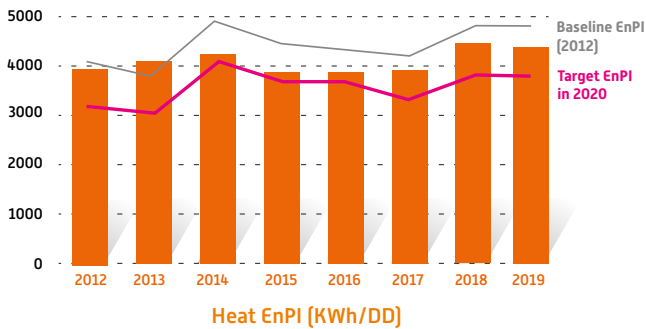
Since 2013, CIRAD has deployed on its main site in Montpellier an operational process management methodology to plan, coordinate and optimize long-term management of energy, water and waste.

### Sustainable management of energy consumption

A first investment phase has focused since 2016 on the renovation of heat networks, the replacement of existing energy equipment and installations with higher performance systems, and the deployment of a smart energy management system to

better align energy supply with actual consumption requirements. CIRAD is on track to meet the first targets for 2020:  
 – a 10% reduction in electricity consumption;  
 – a 20% reduction in heat consumption relative to 2012.

Evolution of performance indicators (EnPI). CIRAD, Montpellier, 2012-2018



### Responsible waste management

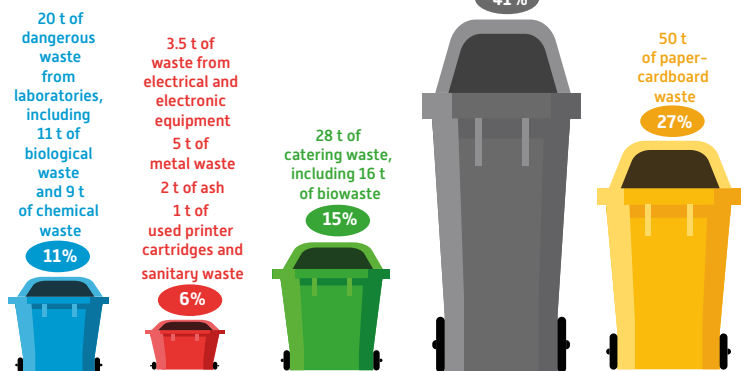
CIRAD has adopted centralized management of its waste from activities in Montpellier to control the risks of pollution and to encourage better recycling. This organization is based on the traceability of waste sorting, storage and transport processes for appropriate treatment and favours local channels.

The development of new recycling processes is an opportunity to innovate, to limit the costs of treatment and to reduce the environmental impact.

In total, 110 kg of waste were generated per employee in 2019, which represents a reduction of 19 kg since 2012 for the sites in Montpellier.

### Distribution of waste by category

CIRAD, Montpellier, 2019



## Day-to-day, mobilizing levers of action to reduce the environmental footprint

### Carbon footprint

In 2018, the establishment conducted its fifth internal carbon assessment, covering all of the sites it owns. The 12% reduction in greenhouse gas emissions for the energy component over the period 2012-2018 reflects the energy saving efforts made. The carbon footprint for business travel – directly linked to our action in the countries of the global South – will, in 2020, be the subject of efforts to draft a charter on air travel, with the difficulty of the legitimate need for such travel for our activities in tropical and Mediterranean countries, our “field of action”.

### Office paper

CIRAD is part of the PAP 50 “Environmental assessment of paper product use” system, led by the World Wildlife Fund (WWF). It encourages good practice through dematerialization (pay slips, invoices, etc.) and awareness among employees of a responsible printing policy. Office paper consumption has been reduced by about half since 2012.

### Pesticide use

In the context of its activities, CIRAD conducts research on agroecological practices aimed at providing sustainable solutions and limiting pesticides. In line with its core business, the plant collections in experimental greenhouses are protected using beneficial insects and biological control methods, with pesticide use limited to 2%. CIRAD has also banned chemical pesticides from maintenance practices on its different sites (Montpellier, Guadeloupe, Martinique and French Guiana). “Zero pesticide” is one of the conditions for obtaining the refuge label from the French bird protection league.

### Water consumption

Where water resources are concerned, CIRAD uses rainwater tanks to water and cool the experimental greenhouses on the Lavalette campus in Montpellier. The need to save water has also led it to drastically reduce watering of green spaces, using mulching techniques and opting for plant species suited to the local climate.

### Going beyond greenhouse gas emissions reporting thanks to our scientists

The TOLTECA process was born from a shared desire to advance research and to reduce the environmental footprint of our activities. At the scientific level, it explores the application of life-cycle assessment (LCA), a method initially developed for goods or services, at the

so-called “meso” levels, especially that of an organization (CIRAD). LCA could be applied to territories, which are key levels for the development of sustainable societies and one of our six key thematic fields.

Life-cycle assessment includes 16 more criteria than the greenhouse gas reporting process, including effects on health, ecosystems and natural resource availability. Applied to CIRAD, it can be used to inform valuable multi-criteria decision making.

## Sustainable procurement

### Environmental and social clauses in procurement

CIRAD includes in its call for tenders social and environmental clauses aimed at encouraging innovation and access to SMEs. It follows the recommendations of the Direction des Achats de l'Etat (DAE - State procurement department) and goes even further:

- procurement with environmental provisions: DAE, 15%; CIRAD, 27%;
- procurement with social provisions: DAE, 20%; CIRAD, 23%
- procurement from SMEs: DAE, 5%; CIRAD, 84%.

## Healthy, sustainable food

Over the last few years, CIRAD has implemented a sustainable catering process on its Montpellier campuses, with meals prepared on-site using certified, high nutritional value products and vegetarian alternatives. 70% of the dishes cooked in 2019 used fresh, seasonal ingredients.

Special care has been taken to source local or regional food products. Thus, most fruit and vegetables used are from

a peri-urban farm close to the Montpellier sites. Bread is made by an inclusive association of bakers, structured around local organic wheat-flour supply chains. The meat and yoghurts used are produced on a small scale in the Lozère department.

Measures have been taken to reduce food waste and to recycle biowaste. The average amount of biowaste per meal fell by 43% between 2016 and 2019, from 144 to 82 g.

## CIRAD sets up a Research Impact and Marketing Service (DIMS)

In January 2019, CIRAD created the Research Impact and Marketing Service (DIMS), under the Office of the Director General in charge of Research and Strategy (DGD-RS). The objective of the DIMS is to align CIRAD's scientific activities with societal demands and especially with the operational demands of donors and contracting bodies.

### Building CIRAD's impact capacity in four areas

With the DIMS, CIRAD aims to better align its day-to-day activities with its strategic priorities at the operational level, to boost its reputation among decision-makers and official development assistance policymakers, to strengthen its strategic partnerships with leading national and international actors in the field of scientific cooperation for development in the global South and, finally, to more effectively mobilize the human and financial resources needed to achieve the four goals that are central to its strategic vision.

Since 1 January 2020, the Service has been structured around three divisions:

- Impact and knowledge of donor strategies..

- Private partnerships and innovation transfer and development.
- Research and development project engineering.

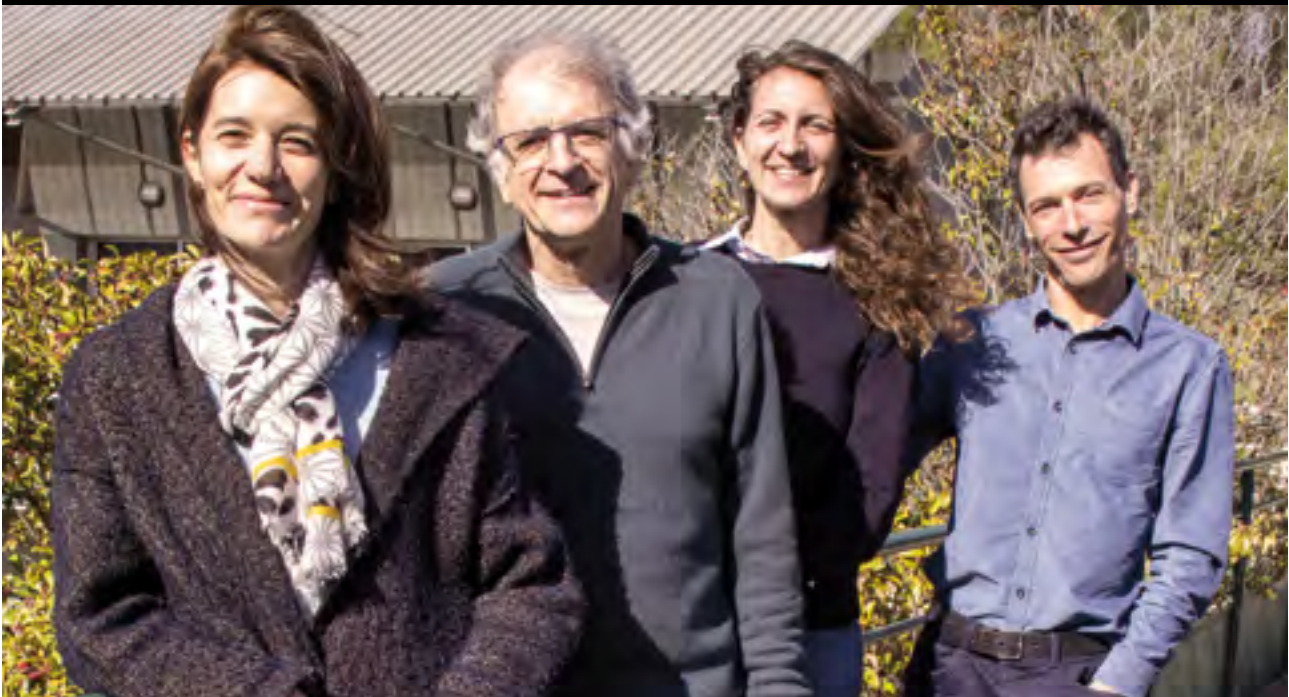
### Providing personalized support to teams

This support covers all components of the construction process for CIRAD's scientific and partnership activities, as well as knowledge and dialogue with all actors involved (public and private donors, companies).

Specifically, it entails:

- > Optimizing the engineering of all CIRAD's contract projects, throughout their life cycle.

From left to right: Lisa Blangy, Head of Private Partnerships and Innovation Transfer and Development; Alain Billand, Manager; Christelle Monier, Head of Research and Development Project Engineering; Sloan Saletes, Deputy Manager. Absent from the photo, Thierry Giordano, Head of Impact and Knowledge of Donor Strategies.





- Proposing and coordinating the framework and instruments for marketing CIRAD's activities (promoting and developing CIRAD's research innovations).
- Building tools to monitor demand and producing analyses of policymakers' expectations and their possible consequences for the project portfolio.
- Promoting a culture of impact, not only within CIRAD, but also with its partners worldwide and with donors.

## First tangible results

The DIMS has played a very active role in coordinating the implementation of a major wave of projects in partnership, financed by the European DeSIRA initiative\* (co-financed by the European Union and AFD). These projects involve amounts ranging between 2 and 10 million euros.

In the Sahelian zone, CIRAD and its partners are involved in six DeSIRA initiative projects, in line with the eight priorities of the Ouagadougou Declaration.

### ABEE

Strengthening plant breeding networks and capacities for the development of resilient crops in Senegal, Burkina Faso and Niger. Leader: WECARD

### ACCEPT

Access to agro-pastoral resources in Chad. Leader: RED

### BIOSTAR

Developing sustainable bioenergies using crop residues or processing waste, in Burkina Faso and Senegal. Leader: CIRAD

### CASSECS

Measuring carbon sequestration and greenhouse gas emissions in agro-silvo-pastoral ecosystems in Senegal, Burkina Faso and Niger. Leader: ISRA

### FAIR

Agroecological intensification in Burkina Faso, Mali and Senegal. Leader: CIRAD

### IRRIN

Developing innovative irrigation practices and technologies in Burkina Faso. Leader: CIRAD

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\*The DeSIRA initiative (*Development Smart Innovation through Research in Agriculture*) was launched during the One Planet Summit in Paris in December 2017. Led by the EC Directorate-General for International Cooperation and Development (DG-DEVCO), its goal is to support agriculture and food systems in the global South through innovation to make them more resilient to the effects of climate change.

## The 2019-2023 Contractual and Performance Objectives

CIRAD's new 2019-2023 Contractual Objectives are set against an eventful backdrop with which the establishment must align its operations. The adoption of major international agreements, such as the United Nations Sustainable Development Agenda and the Paris Climate Agreement, is the common thread of a science geared towards a sustainable future for the planet and for humankind.



For the first time in history, the 17 United Nations Sustainable Development Goals (SDGs) have mobilized all the countries of the world in a common approach centring on shared ambitions. In view of its mandate, CIRAD is working to achieve these goals, especially the fight against poverty and zero hunger, through partnerships and scientific cooperation aimed at enabling innovation and sustainable impacts for responsible agricultural production and consumption. The aim of the Paris Climate Agreement is to keep the increase in global average temperature by 2030 to below 2°C. CIRAD will focus its efforts on helping the most at-risk and resource-poor countries.

The two major programming laws adopted in 2019, one on international development and solidarity, and the other on research, concern CIRAD as a state operator whose mandate is development through research. The Contractual Objectives set out the organization's operations for the next four years. These new objectives, drafted in accordance with ministerial strategies\*, are also based on the 2018-2022 Strategic Vision and on its operational translation into the 2019-2023 Scientific and Partnership Strategy Objectives. This document guides exchanges and interactions with CIRAD's line ministries. It confirms the establishment's priorities, the four objectives (Science – Partnerships – Training – Impact and Innovation) and its resources policy. The objectives set by CIRAD and their monitoring are broken down into eight indicators accompanied by 50 deliverables, concrete outputs of the implementation of institutional strategy.

CIRAD must now continue to evolve in order to consolidate its planning capacity, to strengthen its presence among its local partners and to use all of its expertise towards its priorities for action.

<https://www.cirad.fr/en/who-are-we/our-strategy>

\* The national research strategy (MESRI, 2014, currently being revised; 2017 White Paper); the new guidelines on French development policy (CICID, 2018); the French international strategy on gender equality (MEAE, 2018); the French international strategy on food security, nutrition and sustainable agriculture (MEAE, 2019); the national plan for open science (MESRI, 2018); the MAA Europe and international strategy (2018).



Biodiversity



Integrated health approach



Agroecological transitions



Territories



Food systems



Climate change

## PARTNERSHIP

# A project to control animal diseases in Zimbabwe more effectively



P. Poilecot © CIRAD



The CAZCOM project, coordinated by CIRAD, aims to boost Zimbabwe's autonomy in terms of animal disease control. It comprises three types of support: technical and academic training, molecular biology capacity building, and the introduction of animal and zoonotic disease surveillance systems. Through 20 training courses and 640 hours of academic teaching, the project is to provide training for researchers, technicians, engineers and diagnosis specialists.

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## SCIENTIFIC RESEARCH

# Using artificial intelligence to model complex agroforestry systems



Modelling complex agroforestry systems is a real challenge. To succeed, researchers at CIRAD and their partners had the idea of using artificial intelligence.

The project focuses on cocoa agroforestry systems in central Cameroon.

*"These agroforests are characterized by high diversity: cocoa trees, different fruit trees and several other plants. In addition, they are not organized geometrically, which further complicates our goal of representation",* says Émilie Peynaud, a modeller at CIRAD who is coordinating the project.

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## SCIENTIFIC RESEARCH

# Biological control can limit deforestation and biodiversity loss



© P. Moonjuntha (Thailand Department of Agriculture)



Biological control of invasive species is often perceived as an environmentally risky practice. Yet it can restore crop yields and ease agricultural pressure on the environment, while contributing to forest conservation. This is the conclusion of an article just published by an international team, including CIRAD, in *Communications Biology - Nature*. The paper illustrates the positive impacts of a biological control process implemented in Southeast Asia against the cassava mealybug, *Phenacoccus manihoti*.

Communications Biology  
<https://doi.org/10.1038/s42003-018-0257-6>

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## EXPERTISE

## CIRAD, a major sugarcane research player



© R. Carajou, CIRAD

CIRAD has been appointed to the governing bodies of the International Society of Sugarcane Technologists (ISSCT) for 2019-2022. Régis Goebel will chair the Technical Programme Committee, while Bernard Siegmund, from eRcane, is on the Executive Committee. Angélique D'Hont, for her part, is head of the Biological Commission. It is worth recalling that in terms of sugarcane, CIRAD and its partner eRcane specialize in elite varieties, the Visacane quarantine service, agroecological innovations, and genome analysis.

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## EXPERTISE

# Fertilpéi, the first fertilizer made in Réunion from sewage farm sludge



This is the first time that the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) has authorized the sale of such a product in Réunion. Fertilpéi is a novel fertilizer, produced locally by recycling sewage sludge from the Grand-Prado sewage farm. Among other things, it could be used on sugarcane crops, instead of imported chemical fertilizers. CIRAD has assessed the long-term agronomic and environmental impact of its use.

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Charles Detaille, metrology engineer with the Recycling and Risk Research Unit and instrumentation manager for the Soere Pro Réunion platform, installing automatic chambers to measure nitrogen volatilization and greenhouse gas emissions linked to fertilization practices  
© CIRAD, R. Carayol

## FOCUS: SAHEL

# Milk, a powerful lever for development in the Sahel



B. Faye © CIRAD



Buoyed by ever-growing demand, dairy supply chains in Africa could prove to be a powerful lever for development, notably in the Sahel, where milk is a cultural centrepiece. The idea of strengthening those supply chains that use local milk is steadily gaining ground.

CIRAD is supporting this dynamic, thanks to the expertise built up in the field over many years. Along with OXFAM, it recently published a guidance note, *Pour une alliance renouvelée entre industriels et éleveurs laitiers en Afrique de l'Ouest*, and is coordinating the Africa-Milk project, which aims to secure supplies to dairies.

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# Scientific research as a development driver

In the light of the challenges posed by sustainable development of countries in the global South in the current demographic, climate, environmental and social context, CIRAD and its partners are convinced of the growing need for knowledge and innovations. To address those challenges and succeed in using research to support societies in the global South through a range of unprecedented transitions, CIRAD has identified six key thematic fields.

Each of those fields covers a major research issue shared with our partners in the global South, in which CIRAD has opted to invest collectively, taking an integrative, multi-disciplinary approach, with the aim of renewing, diversifying and extending its scientific outputs and partnerships.

## Identifying climate vulnerability hotspots more effectively



Vulnerability to climate risks can now be determined using a novel assessment and modelling tool developed by the International Center for Tropical Agriculture (CIAT) and CIRAD. Pinpointing zones in which food security is most threatened will target investments in favour of priority rural communities in need of help in order to adapt.

The tool, developed by scientists from the International Center for Tropical Agriculture (CIAT) and CIRAD, generates maps summarizing the different elements of the concept of vulnerability: exposure to risks, crop sensitivity to climate change, and the adaptive capacity of local people.

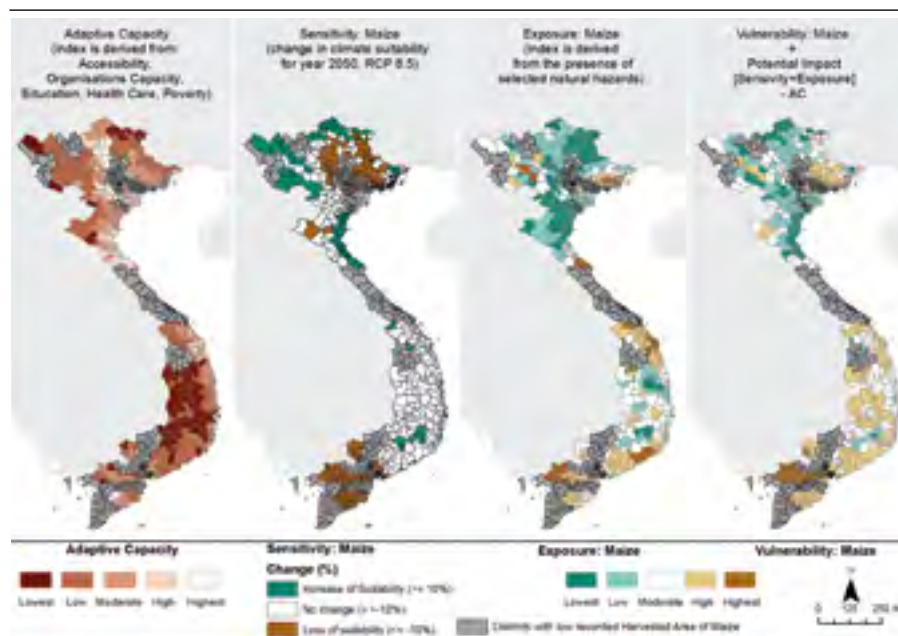
Researchers used the tool to assess climate impact by 2050 on the five crops most crucial for food security in three countries that embody

climate shocks in store for the coming decades (droughts, floods and extreme temperatures): Vietnam, Uganda and Nicaragua (Article published on 27 March 2019 in Plos One). *“We chose very contrasting developing countries that are nevertheless all under threat from climate change, with a strong agricultural economy”*, says Clément Bourgoïn, a geography PhD student. The tool developed is both flexible and reproducible, and could be applied to other world zones.

In Vietnam, by 2050, over 95 percent of the Mekong Delta will lose climatic suitability for rice cultivation, but fortunately, the region is marked by a relatively high capacity to adapt.

Louis Parker and Peter Läderach from CIAT-CGIAR stress that the results, obtained on a very fine scale (district), will enable national decision-makers to pinpoint the most vulnerable rural communities and target zones for priority support.

Maize vulnerability to climate change (2050) under a scenario of high emissions in Vietnam



© L. Parlier, C. Bourgoïn A. Martinez-Valle, P. Läderach (Plos One)

### PREDICTING MANGO PRODUCTION IN THE SAHEL

Drones and image recognition can be used to estimate yields from mango orchards in the Sahel. This was the result of a project in Senegal, with the main aim of adapting to yield heterogeneity at the individual tree level as well as at that of the orchard. *“One of the openings for my research is a smartphone application to help mango farmers estimate their future yields”*, says Julien Sarron, a PhD student at CIRAD. *“To obtain an accurate yield estimate, a farmer will just need to take a few photos of his mango trees and enter information about his plot”*.



<https://doi.org/10.3390/rs10121900>

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<https://doi.org/10.1371/journal.pone.0213641>

### A HIGH-PERFORMANCE GREENHOUSE TO EXPLORE HOW PLANTS REACT TO CHANGE

A new greenhouse on CIRAD’s Montpellier campus can simulate tropical climates precisely in order to determine how plants react. This high-performance ecophysiology facility is the only one of its kind in France. It comprises six greenhouse compartments and six walk-in chambers, with the possibility of controlling climate conditions (temperature, humidity, CO<sub>2</sub>), light intensity inside the chambers, and supplementary lighting, using calibrated LEDs in the compartments.

[umr-agap.cirad.fr](http://umr-agap.cirad.fr)



L. Rodriguez © CIRAD



## AgriNumA 2019: the biggest digital agriculture event in West Africa



Digital technology can be a powerful driver for agriculture, consumption and marketing, and African agriculture could use it to boost its economic, environmental and social performance. This was the main topic for the first regional symposium on digital agriculture in Africa, AgriNumA, held in Dakar (Senegal) in April.

More than 100 players from the digital and agricultural sectors – academia, industry and civil society – in West Africa took part in the first edition of AgriNumA. This major digital agriculture event, organized by CIRAD in collaboration with the International Laboratory for Computer Sciences and Applied Mathematics (LIRIMA), began with an exhibition in which some twenty firms in the region presented their digital agriculture products and

projects. Day 2 was given over to a series of talks on the ecosystems that favour digital agriculture and agrifood innovations, including a presentation of Digital Africa and a round table on the conditions for the emergence of such ecosystems. Two thematic sessions covered the new possibilities offered by digital technology in terms of farm management and supporting value chain stakeholders and public policy. Workshops, followed by round tables,

looked at the use of big data, artificial intelligence and data science, the development of new services involving digital technology, and specific skill requirements. The symposium ended with a debate on emerging research and development issues and the collaborations required to tackle them.

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## SARRA-O, a model to monitor cereal crops and forecast yields in West Africa

The SARRA-O model serves to monitor the growing season for millet, sorghum and maize in West Africa, to determine the best time to sow, and crop water requirements, or forecast yields two months before harvesting. The tool, developed by CIRAD and its partners, offers a range of climate services and can model crops on a national and even a regional scale. It is an early warning instrument in the event of food crises, and a vital risk management tool.

SARRA-O has been tested in the field since 2016 by AGRHYMET, a centre specializing in agro-hydro-meteorology in West Africa, which is using it to produce a monthly bulletin monitoring the agricultural season. It has been so successful that national meteorological office staff from eight West African countries recently trained to use it. "SARRA-O is free, simple, quick and robust. It provides continuous information within a few days, using free, easily accessible data", says Christian Baron, the CIRAD researcher behind the model.

SARRA-O is already fuelling the agriculture component of several development projects being conducted with the World Meteorological Organization, the World Bank and Météo-France, and is also regularly used in research aimed at assessing the impact of climate disruption on agricultural operations

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SARRA-O, a model developed by CIRAD, combines a food crisis early warning system with agriculture-related climate services. It is the fruit of 30 years' development work and is currently being rolled out, with a presentation at AgriNumA, the main digital agriculture event in West Africa, organized by CIRAD in April.



© E. Vintrou

## Hevea genomic selection comes to the rescue of the rubber value chain



**Breeding more productive trees and intensifying latex production would help satisfy growing global demand for natural rubber. The challenge is to avoid extending rubber plantings at the expense of forests, and to boost smallholder incomes. Genomic selection, which has been tested by CIRAD, looks promising.**

**E**very year, 12 million tonnes of natural rubber are produced worldwide, mainly in Southeast Asia. Tyres, shoe soles, surgical gloves, bottle nipples, etc., etc... global demand is booming, and looks set to top 19 million tonnes per year by 2025.

From observations at two sites in Ivory Coast, researchers have been able to predict yields accurately, based on the trees' DNA profile. According to their tests, genome selection would boost genetic progress by 10% compared to conventional techniques. Estimating the value of a broader range of candidates multiplies the chances of pinpointing really promising trees, and saves a great deal of time. The results of the study were published on 27 June 2019 in *Industrial Crops and Products*.

Following on from this work, in 2020, researchers will be rolling out a new breeding scheme, involving DNA analysis, trials, crossing and observations, in association with the Institut français du caoutchouc.

CIRAD is also a member of the Global Platform for Sustainable Rubber, a multi-stakeholder platform for zero-deforestation rubber.

<https://doi.org/10.1016/j.indcrop.2019.111464>

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Producing natural rubber by tapping *Hevea* trees © V. Le Guen, CIRAD



## The first high-density genetic map of greater yam, *Dioscorea alata*

Researchers from CIRAD recently published the first high-density genetic map of greater yam, *Dioscorea alata*. It is the result of an analysis of the links between genetic markers within two populations produced by hand-pollinating genetically contrasting diploid parents. All the progenies and parents were propagated and planted out to enable phenotyping. At the same time, a protocol for genotyping the yam by sequencing was developed and applied to those populations. The information obtained was compiled to produce the genetic map. The study also served to describe the homology with *D. rotundata* and to detect sex-determining QTLs. The results should facilitate sequencing of the *D. alata* genome, improve knowledge transfer within the *Dioscorea* genus, and give rise to new research into the evolutionary history of yams and the determinism of major characters.

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<https://doi.org/10.1007/s00122-019-03311-6>

<http://africayam.org/>

Planting the study populations (CIRAD Roujol, Petit-Bourg, Guadeloupe) © CIRAD



Culex pipiens. © Wikimedia Commons



## Getting to know the bacterium *Wolbachia*, an ally in the fight against mosquito-borne diseases



The bacterium *Wolbachia*, which is found in more than 70% of insects, can affect their reproduction and reduce transmission of pathogens such as malaria, dengue or Zika virus by numerous mosquito species. Researchers from INRA, CIRAD, CEA and the University of Montpellier, and Chicago and Vanderbilt Universities in the United States, have developed an innovative method for analysing the genome of the bacterium *Wolbachia* on an individual level. By sequencing and studying all DNA present in the ovaries of *Culex pipiens* mosquitoes, the researchers identified for the first time a novel plasmid-type genetic element in the bacterium. This discovery paves the way for new research to better understand the interactions between *Wolbachia* and its host mosquito, and its role in disease transmission, providing opportunities for biological control, a major public health challenge. The research was published in *Nature Communications*.

<https://doi.org/10.1038/s41467-019-08973-w>  
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## Tree microbial symbioses play a key role in climate regulation



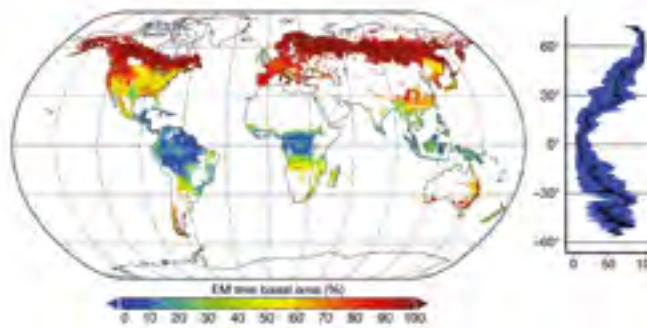
The Global Forest Biodiversity Initiative (GFBI), of which CIRAD is a member, recently published a global map of tree microbial symbioses. It shows that if carbon emissions continue at current rates, 10% of tree ectomycorrhizal fungi will have disappeared by 2070. In a snowball effect, this would trigger even higher carbon emissions.

Some 28 000 species and 31 million forest trees on every continent were sampled and modelled to produce a global map of symbioses between trees and microorganisms. "A symbiosis is a sustained intimate relationship that benefits two living organisms from different species", Bruno Hérault, a tropical forest specialist with CIRAD who was one of the authors, explains. "Our work confirmed the hypothesis that endomycorrhizas – microscopic fungi that penetrate tree roots – are abundant in tropical forests and ectomycorrhizas – which simply surround the roots – in cold climates." The frequency of these two types of mycorrhizal symbioses is thus closely linked to climate variables, which also

affect the rate of soil organic matter decomposition: the leaf litter of trees with ectomycorrhizas decomposes slowly, which contributes to soil carbon capture. Ectomycorrhizal symbiosis thus plays a key role in climate regulation. By simulating the evolution of their global distribution between now and 2070, in view of current climate change, the researchers showed a global loss of 10% of ectomycorrhizal fungi, triggering a new increase in atmospheric carbon levels.

<https://doi.org/10.1038/s41586-019-1128-0>

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Map of ectomycorrhiza abundance worldwide (as a percentage). They are concentrated in colder climates  
© B. Steindinger, Stanford University

## Boosting the sterile insect technique with a biocide increases its efficacy



Boosting the sterile insect technique with low doses of biocides transported by sterilized males could improve control of mosquito-borne epidemics, as shown by researchers from CIRAD and INRA, in collaboration with the FAO-IAEA Insect Pest Control Section. The technique could reduce by more than 95% the total number of sterile male mosquitoes needed to circumvent epidemics, and drastically reduce the cost of vector control. This research was conducted as part of the ERC REVOLINC project,

which explored this idea for several insects, including *Aedes albopictus*, the tiger mosquito, a vector of dengue, chikungunya and Zika. Different biocides were tested in order to select the most effective, but also the most specific, to avoid any environmental contamination. Eventually, the project team plans to test densovirus, as highly specific biopesticides against *Aedes albopictus*.

<https://doi.org/10.1038/s42003-019-0451-1>

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Contaminating the genitals of a female *Aedes albopictus*  
© L. Laroche



## A WORD FROM A PARTNER

### In Cambodia, CIRAD and its partners are helping the government with the agroecological transition

**Rada Kong, an agronomist, is one of the prospective leaders of the ASSET regional project on agroecological transitions and healthy food systems in Southeast Asia, a key project for the Agroecology for Southeast Asia (ASEA) platform in partnership for research and training for the coming five years.**

#### At what point in your career did you work with CIRAD?

I met Stéphane Boulakia\* in 2017, when he was technical advisor to the Ministry of Agriculture, Forestry and Fisheries in Cambodia. I was lucky enough to have him supervise my Masters on integrated management of rural and agricultural development (University of Copenhagen-IRC/SupAgro Montpellier). I then carried on working with CIRAD, on the adoption of conservation agriculture and its scaling-up in the highlands of northwestern Vietnam, then in Cambodia. In 2016, I decided to do my PhD at CIRAD, with Florent Tivet\*\*, on the agrarian systems of northwestern Cambodia. I set out to understand agricultural transformations, in the hope of pinpointing agroecological transition drivers. In 2019, I took part in the first workshop organized by dP ASEA, which works to support large-scale agroecological transition.

#### What role is CIRAD playing in the agroecological transition of farming systems in Southeast Asia?

In Cambodia, for instance, through dP ASEA, CIRAD and its partners are helping the government, particularly the Ministry of Agriculture, develop a platform called CASIC (Consortium for Conservation Agriculture and Sustainable Intensification). The consortium associates farmers, institutional players, academics, microfinance bodies, development operators and private-sector representatives (agricultural equipment and bio-input suppliers). In addition, in 2019, Cambodia signed up to the "4 per 1000" initiative on soil carbon capture, and will be hosting a regional conference on the topic this year.

#### What is the added value of your work?

My thesis work proved the need to support agroecological transition by involving the whole range of stakeholders and covering different scales, from plot to territory. It also highlighted the importance of assessing the performance and impact of innovations, in terms of productivity, obviously, and also on an economic, social and environmental level. Those assessments give decision-makers reliable field data and contribute to the policymaking process.

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Rada Kong began his career as an agronomist with an agricultural development support project (PADAC) funded by AFD and implemented jointly by CIRAD and the General Directorate of Agriculture in Cambodia (GDA), one of the founding members of dP ASEA

#### BIOGRAPHY

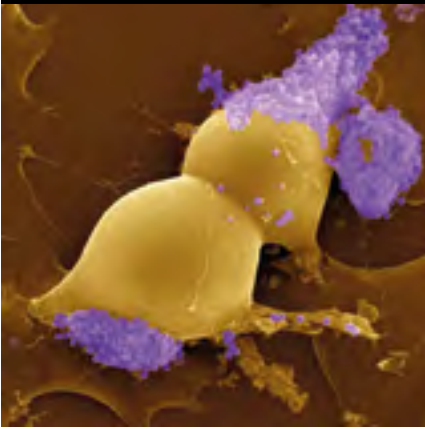
Rada Kong studied at the Royal University of Agriculture (RUA) in Cambodia, where he looked at agriculture and farmers' living conditions in the country. In 2004, his first research project led him to replace meat-and-bone meal with water spinach (*Ipomoea aquatica*) in the diet of farmhouse pigs.

\* Agronomist at CIRAD, Agroecology and Sustainable Intensification of Annual Crops research unit (UPR AIDA).

\*\* Agronomist at CIRAD, UPR AIDA. Assigned to Cambodia, with the Department of Agricultural Land Resources Management, General Directorate of Agriculture (GDA).



The pathogenic bacterium *Ehrlichia ruminantium* (purple) stuck to a dividing bovine endothelial cell (yellow) (false-colour scanning electron microscopy image, 40 000x magnification) © D. F. Meyer, CIRAD



**R**ather than tackling bacteria “head-on”, which prompts them to defend themselves, we want to make them ineffective by making their host more resistant. To do so, we are trying to identify the arsenal of weap-

## Protecting against bacteria without using antibiotics



Whenever a new antibiotic is launched, bacteria generally take less than two years to find a way around it; hence the need to find alternatives. CIRAD’s Damien Meyer and his peers are working to make bacteria ineffective without resorting to antibiotics.

ons used by bacteria to “zombify” the cells they infect”, says the researcher, who is working on *Ehrlichia ruminantium*, the bacterium that causes cowdriosis, a disease that kills ruminants in the tropics.

When a pathogenic bacterium penetrates a cell, it has only one aim: to replicate, reprogramme the cell, and colonize the entire organism. To this end, it injects the cell with proteins known as “effectors”. The researchers’ work therefore consists in pinpointing the effectors produced by the bacterium, their targets, and precisely how they work. An initial

effector, ERIP 1, has been identified in *E. ruminantium*. Once researchers have determined how it works, they will be able to counter it and protect attacked cells more effectively. Other possible solutions are available, including using how ticks tolerate bacteria with which they live in symbiosis. “Identifying how tick cells tolerate bacteria could allow us to trigger similar mechanisms in susceptible hosts”, Damien Meyer concludes.

<https://doi.org/10.1371/journal.pcbi.1006847>

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## A rapid test to detect Rift Valley fever



In Réunion, a team from CIRAD has developed the first specific rapid detection test for Rift Valley fever (RVF). The possibility of identifying the virus instantly paves the way for more effective prevention of RVF epizootics like the one in Mayotte up to last summer.

**T**his rapid detection test identifies every strain of the RVF virus. It is based on antigen-antibody recognition, and enables early warnings of the disease”, Catherine Cêtre-Sossah, a CIRAD researcher involved in developing the test, explains.

This instant diagnostic test can thus detect the virus as soon as it appears. Only level 3 containment laboratories could identify the virus up to now, and they will still be required to confirm the result.

Along with existing epidemiosurveillance networks, the test can be used to implement

prevention and early warning measures. Its sensitivity is due to be improved still further before its commercial launch, within the next two years.

<https://doi.org/10.1371/journal.pntd.0007700>

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This study was funded by ERDF INTERREG V TROI 2015-2020 (European Union) and the Réunion Regional Council under the One Health Indian Ocean platform.



Instant identification of the Rift Valley fever virus in animal blood paves the way for more effective disease prevention © R. Carayol, CIRAD

### A LETHAL ZOOZONOSIS FOUND IN AFRICA AND THE INDIAN OCEAN

Rift Valley fever (RVF) is a virus that primarily affects ruminants. As its name suggests, it originated in the Rift Valley, and it is zoonotic, ie it can affect both animals and humans.

The disease is fostered by outbreaks of certain mosquito species that carry it. It was restricted to Africa until the 2000s, but could eventually reach Europe via the spread of the mosquito vector species, at least partly linked to global warming.







# Expertise

in support of  
agricultural value chains  
and public policy

CIRAD has exceptional, longstanding and recognized expertise in the technical aspects of tropical agricultural value chains, notably for renewing production approaches to include the concepts of agroecology.

CIRAD also provides scientific and institutional support for public policymaking in the countries of the global South, while contributing to international debate on major global issues such as agriculture, food, biodiversity and climate change.

Lastly, CIRAD considers that ensuring long-term agricultural development in the global South and drafting appropriate public policies means generating relevant knowledge.

This development through research relies on the capacity of countries to build suitable higher education and research systems. Training (both academic and professional) in the global South is a vital aspect of CIRAD's operations.



Julien Demenois, ecology researcher and 4 per 1000 correspondent at CIRAD © C. Dangléant, CIRAD

## “The IPCC report on climate change and land tallies with CIRAD’s position”



The agricultural sector is capable of reducing its greenhouse gas (GHG) emissions and adapting to climate change, according to a special report on climate change and land by the Intergovernmental Panel on Climate Change (IPCC), the contents of which tally with CIRAD’s position.

“As scientists, we should be helping policymakers and economic decision-makers seize on the report and take action.”

### The IPCC has just released a special report devoted to land use, which is a first. What do you think about it?

The report pinpointed the links between agriculture, climate change and food security. This confirms the relevance of CIRAD’s work and its research strategy, and the IPCC’s reputation could ensure greater awareness on the part of decision-makers.

### What is the IPCC’s main conclusion?

It says that even the target set in the Paris Agreement (limiting global warming to 2°C at most and preferably to 1.5°C compared to pre-industrial times) poses a significant risk for global food security. It is crucial that we transform our farming and food systems, to limit the increase in GHG emissions from the agricultural sector. This echoes the work CIRAD has been involved in for some ten years now.

### The foresight exercise initiated by the Agrimonde study between 2006 and 2010 was a precursor, wasn’t it?

Yes, it was the first to look back at every aspect of the evolution of the world’s agriculture and food supplies.

One of the proposed scenarios was already based on agroecology and agroforestry for production, and on changing food habits, for instance reducing animal product consumption.

### How does the IPCC suggest we adapt to climate change and mitigate its effects?

The IPCC recommends increasing organic matter levels in soils (in line with the 4 per 1000 initiative involving CIRAD), agroforestry or reforestation. CIRAD sees such compromises as some of the most appropriate solu-

tions. As scientists, we should be helping policymakers and economic decision-makers seize on the report and take action. To this end, the Koronivia process, in which CIRAD is actively involved, intends to lobby COP climate negotiators.

### Does the report address the vulnerability of tropical farming systems?

Although the countries of the global South emit less GHG, they are more vulnerable to cli-

mate change than those in the North. Like us, the IPCC highlights the rate of population growth and the high impact of climate change in arid and semi-arid zones, for instance in the Sahel, which could worsen the living conditions of already vulnerable population groups.

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Soil in the Sahel © C. Dangléant, CIRAD



## FERTILIZATION, FOR SUSTAINABLE, RESILIENT FARMING SYSTEMS

Last December, for COP25 in Madrid, CIRAD and 19 partner organizations from ten countries submitted a contribution on the topic of organic fertilization.

This was the fourth contribution under the Koronivia Joint Work on Agriculture (KJWA) aimed at ensuring that agriculture is included in climate talks. This latest appraisal concerned the use of nutrients for more sustainable, resilient farming systems capable of mitigating climate change.

# Deforestation in Madagascar: balancing development and biodiversity conservation



**“The Republic of Madagascar has committed to restoring four million hectares of forest by 2030 within the framework of the African Forest Landscape Restoration Initiative (AFR100)”, says Plinio Sist, Head of CIRAD’s Forests and Societies research unit. As 90% of Madagascan species are endemic, this could preserve the island’s unique biodiversity.**



Madagascar has lost 44% of its natural forests since the 1950s and the rate of deforestation is increasing © G. Vieilledent, CIRAD

CIRAD and its partners in Madagascar have launched a long-term process to reduce pressure on natural forests. That pressure is both demographic – the Malagasy population is expected to double between 2015 and 2050 – and economic: there is a need for arable land and for wood and charcoal, the main sources of fuel on the island.

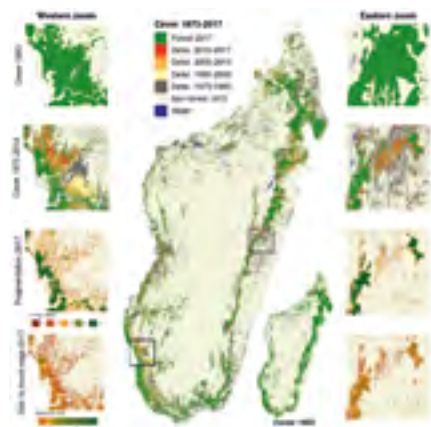
With the Arina\* project, CIRAD is supporting rural populations along the chain, from planting forest trees to the sale of charcoal. The BioSceneMada\*\* project, for its part, will provide policymakers with maps indicating priority areas for conservation and restoration.

At the same time, the Forests and Biodiversity platform in partnership is working to balance agricultural production and forest management, in association with the Sustainable Agriculture through Landscape Management project (PADAP) to propose alternatives to slash-and-burn farming and integrate trees and biodiversity into cultivated areas.

Lastly, CIRAD and its partners are looking at the major export sectors linked to trees (lychees, cloves, etc.), forest crops such as vanilla, and gathered products such as wild pepper (DOM-ETSIP project).

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- \* Integrated forest management and reforestation of Anjozorobe district
- \*\* Biodiversity scenarios under the effect of climate change and future deforestation in Madagascar



Change in forest cover in Madagascar from 1953 to 2017 © G.Vieilledent, CIRAD



## PUBLICATION

*“Public-private partnerships have considerable potential to boost veterinary services”*

In response to epidemiological risks on livestock farms in the global South, public-private partnerships (PPPs) can improve both sanitary conditions and veterinary practices.

To this end, the World Organization for Animal Health (OIE), in collaboration with CIRAD and with the support of the Bill & Melinda Gates Foundation, recently published guidelines to make such partnerships more effective.

International workshops led by CIRAD researchers are serving to support the initiative.

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Livestock farmer in Ferlo (Senegal) © S. Taugourdeau, CIRAD

## GEMAHA PROJECT GENERATING GREEN ELECTRICITY FROM JATROPHA OIL



The inauguration of the power generator at the PhileoL Tsihombe oil mill on 18 June marked the start of a multi-partite project led by CIRAD. The GEMAHA project aims to test the use of oil extracted from the seeds of *Jatropha*, an endemic shrub, as a biofuel, to generate rural electricity. The eventual aim is to supply several rural communities in southern Madagascar with electricity and make use of local biomass, two fields in which the BioWooEB research unit is already working.

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# FOREST FIRES

**“Urgent action is needed to restore tropical forest ecosystems at the territorial level”**

Plinio Sist, Head, Forests and Societies research unit, CIRAD

## The priorities for action in Africa and Amazonia

**During the summer of 2019, Amazonia and Indonesia saw catastrophic uncontrollable forest fires, which were linked to human activity and emitted vast amounts of greenhouse gases. CIRAD is working to help these pilot regions manage forest resources and the forest biome sustainably.**

According to the National Institute for Space Research (INPE) in Brazil, the use of fire to clear forest rose by 83% in 2019 compared to 2018. Some 20% of the Amazon rainforest has been destroyed and converted to agriculture since deforestation began in the 1970s. Some INPE specialists put the point beyond which disastrous savannization would begin at between 25 and 30% for South America as a whole.

Sub-Saharan Africa is also being consumed by flames. Ecosystems south of the Congo Basin are traditionally burnt every year to maintain open spaces. However, with population growth, this ancestral practice has become a major cause of deforestation, and of soil degradation. In some cases, uncontrollable fires have become global catastrophes due to the amounts of greenhouse gases released. Fires accounted for almost 45% of the CO<sub>2</sub> emitted by the land use sector in Africa between 2000 and 2005.

To preserve and restore the remaining forest ecosystems, there is now an urgent need for a sustainable agrarian and forestry transition. In Amazonia, CIRAD is working with the Tropical managed Forest Observatory (TmFO), whose main aim is to draft recommendations for



Grassland fire © SuGak, Adobe Stock

sustainable silviculture. In Africa, CIRAD is a technical partner of the Observatoire des forêts d’Afrique centrale (OFAC). It has also coordinated projects that have provided a clearer understanding of how forests function.

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Patrick Caron\* participated in a meeting of scientists working for Amazonia, on 21 September 2019 during the UN General Assembly in New York. The meeting was organized by Jeffrey Sachs\*\* and chaired by Maria Fernanda Espinosa Garces\*\*\*, and brought together around a hundred participants, who reaffirmed the role of science in shedding light on developments and decisions and concluded there was a need for a group, led by

experts from nine countries in the Amazon Basin and territories, to conduct an independent collegiate appraisal.

\* Geographer with CIRAD and Vice-President for International Affairs, University of Montpellier

\*\* Director, Sustainable Development Solution Network (SDSN)

\*\*\* Chair of the General Assembly

## Current management systems in the Amazonian forests are no longer sustainable

In the forests of Amazonia, selective logging will not produce sufficient timber to satisfy demand in the region in the long term. That is the key finding of a new study led by the Tropical managed Forests Observatory (TmFO), published on 13 June in *Environmental Research Letters*.

**“W**ith current cutting cycles and logging intensities, forest regrowth is too slow to recover timber stocks”, Camille Pioniot, a CIRAD researcher and lead author of the study, explains. Concerted management of wood resources in the Amazon forests is particularly difficult, since nine countries are involved\*. The TmFO team modelled five logging intensity and timber regrowth scenarios, with cutting cycles of between 15 and 65 years. It transpired that the lightest scenarios (low logging intensity and long cutting cycles) do not provide enough timber to satisfy demand, while the heaviest “are not sustainable, as they do not allow sufficient volume recovery during a cutting cycle”, Camille Pioniot adds.

Climate change “will probably lead to more frequent and severe droughts and wildfire events”, says Bruno Hérault, tropical forests expert with CIRAD. “This will lead to increased tree mortality, especially of large trees [loggers’ main target].”

“Important forest policy decisions must be made, to diversify resource use and invest in new forms of timber production, such as planted forests, in order to preserve the remaining natural forests long term”, Plinio Sist, leader of the TmFO, concludes.

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\* Brazil, Ecuador, Venezuela, Surinam, Peru, Colombia, Bolivia, Guyana, French Guiana



View from a drone of degraded forest in Amazonia © C. Bourgoin

## Recurring fires in Indonesia: breaking the vicious circle

Indonesia is now also engulfed in flames. In Sumatra in particular, the culprit is the traditional practice of clearing agricultural land by burning © A. Rival, CIRAD



With every dry season, parts of Indonesia are shrouded in a dense cloud of smoke. CIRAD has conducted field surveys with its local partners with a view to slowing the spread of fires, particularly in peatland areas.

The fires are primarily the result of the traditional habit of clearing agricultural land by burning. However, smallholders would be prepared to stop burning stubble if they were offered an alternative economic outlet, however small, notably by recycling agricultural waste.

“Extreme weather phenomena and extended droughts cast doubt on the resilience of monoculture plantations [oil palm, rubber or eucalyptus]”, says Alain Rival, CIRAD Regional Director for Indonesia. Such systems would do well to shift “towards complex agroforestry systems” capable of recycling biomass by composting and eventually creating microclimates that foster the development of dense agroforests that can stop fires from spreading.

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## Montpellier Declaration: “Make our planet treed again!” Agroforestry as a way of ensuring resilience



Agricultural production in the groundnut basin of Senegal centres on dry cereals (millet) and legume crops (groundnut and cowpea) C. Dangléant © CIRAD

Agroforestry is a vital driver in the fight against global warming. Over a thousand experts called on public policy- and private decision-makers to foster an agroforest transition, in the “Montpellier Declaration” issued following the 4th World Congress on Agroforestry, organized by CIRAD.

**“M**ake our planet treed again!” This was the call that concluded the 4th World Congress on Agroforestry, held for the first time in Europe, in Montpellier, and organized by CIRAD and INRA in partnership with World Agroforestry, Agropolis International and Montpellier University of Excellence.

*“We consider that policymakers, governments and regulators must accelerate the design and rollout of legal, regulatory and support mechanisms to encourage the widespread adoption of agroforestry”, the “Montpellier Declaration” reads.*

The event’s 1200 participants from all over the world agreed that agroforestry was crucial in

responding to the climate crisis. At the congress, many contributions showed that compared to the current simplified, artificial global agriculture model, agroforestry creates richer, more productive farming systems similar to natural ecosystems.

*“Combining trees with crops and pasture contributes to biodiversity and serves to adapt to and mitigate climate change, while boosting food and nutrition security”,* CIRAD’s Emmanuel Torquebiau, Chair of the congress Organizing Committee, explains. This is vital for achieving economic, climate and food resilience.

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**The 4th World Congress on Agroforestry was held in Montpellier from 19 to 23 May 2019.**

Agroforestry, which involves combining trees with crops and pastures, is now recognized to protect soils, address climate change issues and contribute to global food security. This observation provided the backdrop to the 4th World Congress on Agroforestry, held in Montpellier from 19 to 23 May 2019. Open to researchers, students, farmers, NGOs and decision-makers, the congress attracted some 1200 participants from more than 100 countries. It was organized in Europe for the first time, by CIRAD and INRA, in partnership with World Agroforestry, Agropolis International and Montpellier University of Excellence.



# “We need biodiversity in our fields and on our plates”



For Didier Bazile, a CIRAD researcher and member of the French Committee for IPBES\*, biodiversity and ecosystem services are vital for agricultural production. Last April, he attended the 7th IPBES plenary in Paris, to discuss with its 134 member countries the abstract intended for policymakers associated with the global assessment report on biodiversity and ecosystem services.

### What are the main conclusions of the IPBES report?

In 1800 pages, it fine-tunes the diagnosis of a global slump in biodiversity that has gained speed in recent years, and confirms that the resources available to slow that slump are far from sufficient to reverse the trend. The biodiversity loss the report describes is irreversible. We can no longer rely on technological progress to compensate for biodiversity erosion and the degradation of ecosystem services.

### Is that erosion a threat to our farming systems?

Without biodiversity, cultivated and natural ecosystems are highly vulnerable to biotic and abiotic threats. We need biodiversity in our fields and on our plates, to improve not just ecosystem health but also our own. It guarantees healthier, more nutritious food. For instance, old wheat varieties were twice

as rich in protein as those we grow today. CIRAD is in favour of an integrated approach – agroecology – in which biodiversity is a driver for development and resilience. We have to change our view of agriculture, and no longer see it as a means to produce, solely in terms of yields, but consider its impact on ecosystem services and move towards multi-criteria selection and focus on the services agriculture renders to other sectors.

### What is the link with climate disruption?

Climate change is now seen as the third biggest cause of biodiversity loss. However, experts agree that climate change will soon be the main threat to biodiversity and ecosystems. We are expecting a snowball effect. It is difficult to predict when that loss will speed up, but it almost undoubtedly will. Global warming will cause not only substantial yield losses for current species and

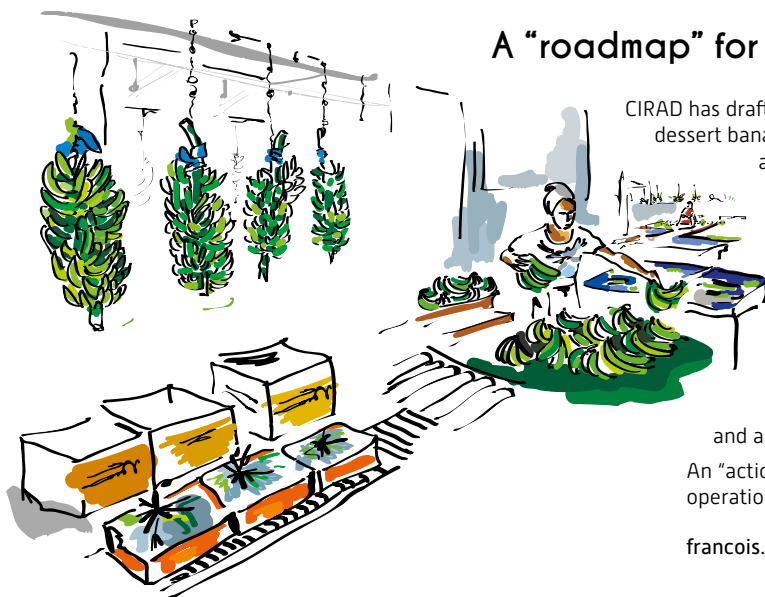
varieties, but also the disappearance of species that are useful to agriculture and the rapid development of new pests and diseases, which will exacerbate its effects.

### What vision is CIRAD defending?

Food, biodiversity, climate and health issues are now closely linked. CIRAD has long had a global vision and a territory-based approach as regards these research topics. Its transverse, multi-disciplinary expertise is one of its characteristics. Proof if proof were needed that we are moving in the right direction is the fact that biodiversity issues are now being taken into account in various sectors the world over.

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\* IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services



## A “roadmap” for the banana value chain

CIRAD has drafted a roadmap aimed at ensuring agroecological, sustainable dessert banana and plantain production within ten years. The document sets a dual target: to generate scientific knowledge of the biological mechanisms and technical and organizational drivers, and to revitalize what CIRAD has to offer in terms of advice, products and services, training, and collaborations.

In the very short term (within five years), the roadmap aims to reduce pesticide use in banana growing zones geared towards export or regional markets. In the medium term (within ten years), new dessert banana production concepts (multi-species systems and systems tending towards agroforestry) should make it possible to achieve “Zero Phyto” and a high level of social and territorial sustainability.

An “action plan” will break down the roadmap into two- to three-year operational stages.

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## FOOD SYSTEMS

On a global level, food and nutritional insecurity persists and is evolving towards new types of food imbalances. While the number of people suffering from hunger (calorie deficit) is struggling to drop below 800 million, the world is facing an epidemic of over- and “junk” consumption (overweight), which concerns more than a quarter of the global population, including in the global South and in middle-income countries.

### How can we feed the world in 2050 without destroying it?

According to the UN, hunger worldwide is on the rise. In its report *Creating a Sustainable Food Future* produced in association with CIRAD, the World Resources Institute (WRI) suggests ways of feeding the world in 2050, drawn up using the GlobAgri platform designed by CIRAD and INRA.

The WRI report estimates that feeding 10 billion people in 2050 without destroying the planet will mean producing 56% more food than in 2010 while saving 600 million hectares of agricultural land and cutting greenhouse gas (GHG) emissions by 11 gigatonnes.

It suggests a “five-course menu”:

- Reduce growth in demand for food;
- Increase production without expanding the agricultural land area;
- Protect and restore ecosystems;
- Increase fish supply;
- Reduce GHG emissions.

The report identifies a set of policy frameworks, innovations and incentives for use in rolling out these solutions on a large scale.

Many of the report’s findings use the GlobAgri model, which quantifies how far each solution can help to increase the availability of food, avoid deforestation, and reduce GHG emissions. “The platform was developed by CIRAD and INRA and used in drafting this World Resources Report”, says Patrice Dumas, a modelling specialist with CIRAD who was involved in developing GlobAgri. During the Agrimonde-Terra foresight study, the model was used to simulate land use changes and food availability in fourteen regions worldwide.

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Agroforestry is one of the innovative farming methods that could cut GHG emissions  
© C. Dangleant, CIRAD

#### PUBLICATION

##### Food systems at risk: trends and challenges

The conclusions of a collective study by CIRAD commissioned by the European Commission highlight the unprecedented number of threats to food systems. The combination of risks, in terms of population, health, the economy and the environment, suggests food crises could become increasingly common.

The solutions found by communities already living with these constraints show that there is no magic bullet: solutions must be found on a local level and tailored to context.



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## Urbal, or how to pinpoint the impacts of innovations on food system sustainability

The Urbal project, coordinated by CIRAD, is studying the sustainability of twelve food innovations in ten cities worldwide. The aim is to provide players with a lightweight, open-source method for characterizing the impacts of innovations on food system sustainability. The initial results are promising.



Ana Paula Boquadi, chef at the Buriti Zen restaurant in Brasília, is one of the chefs working to promote the biodiversity of the Cerrado © Buriti Zen

From producers to consumers, there are many food innovations worldwide. However, it is difficult for project leaders to have a clear idea of their impacts in terms of sustainability, particularly in the case of recent innovations.

*“The Urbal project is working on an easy-to-use tool, based on participation and requiring little in the way of resources”,* says Elodie Valette, a geographer with CIRAD who is co-coordinating the project. *“Rather than measuring impacts, we want to identify the processes by which innovations generate long-term changes”.*

The method looks at six aspects of food sustainability (sociocultural, economic, governance, environment, nutrition, and food security) and is currently being tested in Baltimore, Brasilia, Berlin, Cape Town, Hanoi, Milan, Mexico City, Montpellier, Paris and Rabat. It serves to identify positive and negative impacts, and to pinpoint the conditions for success, the risks, and the points to monitor when developing innovations.

For instance, in Brasilia, Urbal identified the impacts of a project to encourage local chefs to promote the Cerrado biome. It highlighted the nutritional quality of the products used, but also revealed the risk of pressure on resources due to increased demand.

<https://www.urbalfood.org/>

[elodie.valette@cirad.fr](mailto:elodie.valette@cirad.fr)

### THE MILAN PACT

In 2015, at the end of the Milan World Expo, around 100 mayors from all over the world

signed a sustainable food policy commitment, known as the Milan Pact. Some 200 mayors in all have now signed up. The fifth edition of their annual gathering was held in Montpellier from

7 to 9 October 2019, allowing CIRAD to take part in this international meeting and highlight the linkages between urban food and the UN Sustainable Development Goals.

## Patrick Caron’s time as Chair of the HLPE (2015-2019)

The High Level Panel of Experts on Food Security and Nutrition (HLPE), the science-policy interface for the UN Committee on World Food Security (CFS), was founded in 2010. It comprises 2500 experts, and has taken an innovative, rigorous and strictly independent approach to investigate the bottlenecks that hamper decision-making and action. The panel is a vector for scientific diplomacy, and contributes to the political agenda by pinpointing critical, emerging topics, shedding light on controversies, and drafting recommendations.

*“One of the key roles ... is to help members and participants in CFS to understand why they disagree”* Monkombu Sambavisan Swaminathan, First Chair of HLPE

Patrick Caron served two terms as Chair of the panel’s Steering Committee, from

2015 to 2019. He oversaw its operations and represented it at plenary sessions of the High Level Political Forum at UNHQ. Under his chairmanship, six reports\* were published. The 2017 report recommending the drafting of voluntary guidelines on food systems, which are due to be approved in October 2020. The 2019 report on agroecology will fuel the strengthened global agenda on the topic.

*“By differentiating between what stems from a lack of knowledge, conflicts of interest, or power imbalances, it makes an understanding of disagreements a tool for overcoming obstacles and taking action.”*  
Patrick Caron

The reports have demonstrated that diet is now the number one source of public health problems. Although they do not contain



© A. Perrotton, CIRAD

answers to every question, they do provide a shared language for debate and action.

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\* The reports are available in the six United Nations official languages, on the HLPE website: <http://www.fao.org/cfs/cfs-hlpe/fr/>

## From field to fabric: a study of cotton in Cameroon



The cotton value chain in Cameroon also takes charge of cottonseed crushing to produce oil, making it the most integrated in French-speaking Africa. It was recently the object of a study – VCA4D – by a CIRAD team, over the 2017-18 campaign.

The study showed that the chain's profitability was fragile due to the lack of industrial processing capacity and insufficient outlets for the solid by-products of seed crushing. It also revealed that the chain accounted for 0.6% of GDP and that producers generated 38.4% of total added value. Furthermore, 62.2% of the income generated is distributed within the value chain. The study considered production of traditional ceremonial "boubous" (in 100 specialized villages), and three different types of producers, depending on the area planted with cotton.

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Discussions with women cotton producers in a village  
© M. Fok, CIRAD



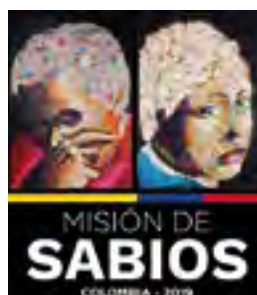
## Colombia: 46 experts sketch a sustainable, equitable future

A group of 46 experts met Colombian President Iván Duque on 5 December to hand over a report on the country's future sustainable development. The aim is to build a "Bio-Colombia" that will be the leading scientific power in Latin America by 2030.

It took the "Mission of Wise Men", comprising 46 experts, eleven months to draft this 300-page report on the Colombia of the future. In his speech on 5 December, Colombian President Iván Duque hailed this "collective work produced over 300 days, for future generations".

The experts recommend investing in science, education and health, to build a sustainable, productive and equitable future. The "Bioeconomy" Commission, which included CIRAD President Managing Director Michel Eddi, seconded by Guy Henry, suggested the country build a sustainable economic model for Colombia, based on natural and cultural diversity and on creativity.

According to Silvia Restrepo, Vice President for Research at the University of Los Andes, who coordinated the Commission, Colombia could stop depending on extractive industry and bet instead on the bioeconomy [see interview on next page].



The aim is to build a "Bio-Colombia" that will be "the leading scientific power in Latin America", the Colombian President said as he signed the decree formalizing the creation of a Ministry of Science, Research and Technology,

which will be tasked with implementing the recommendations made by the "Mission of Wise Men".

Members of the "Biotechnology, Bioeconomy and the Environment" Commission of the "Mission of Wise Men", which included CIRAD President Managing Director Michel Eddi and Guy Henry © M. Ramirez, UniAndes



## A WORD FROM A PARTNER

# ENSURING AN ECONOMIC TRANSITION THAT SAFEGUARDS THE ENVIRONMENT AND HEALTH

CIRAD experts participated in a study on the future for Colombia, with a view to finding new ways of funding research. This marks another milestone in our ongoing partnership with the country, according to Silvia Restrepo, biologist and Vice President for Research at the University of Los Andes.



RR

**You worked with CIRAD experts on this foresight exercise. What can you tell us about it?**

This was the government's third exercise of its type, but this time, a number of researchers from other countries took part. Their expertise really fuelled the debate. In twenty years' time, we will have exhausted our oil and gas deposits, so we urgently need to switch to a sustainable economy centring on natural and agricultural biodiversity.

I chaired the "Bioeconomy" Commission, which included CIRAD's Michel Eddi, seconded by Guy Henry. Their experience in terms of partnerships with industry was particularly inspirational. As things stand, research funding accounts for just 0.2% of gross domestic product, but industry could co-fund research in all sectors, particularly agriculture. The Ecopetrol firm has mentioned a figure of 30 million dollars, and palm oil firms have also expressed an interest.

**What role could CIRAD play in building such partnerships?**

The Ministry of Science, Research and Technology, created by decree last December, needs to sign agreements with indus-

try, and CIRAD has offered to supply us with models and help us develop regional versions.

**Agriculture and biodiversity were a major part of this exercise, aimed at building a sustainable "Bio-Colombia". How could CIRAD's expertise be of use?**

We are a country of farmers. On the export market, our flagship products are flowers, coffee and fruits. Oil palm and cocoa plantations are also gaining ground, to replace coca, in the fight against drugs. Not to mention products intended for the domestic market: rice, cassava and maize. We need to make sure our economic transition safeguards the environment and human health. CIRAD is sharing its bioeconomic expertise to allow us to use what we produce more efficiently, particularly agricultural biomass, which is currently neither used nor promoted.

### BIOGRAPHY

Silvia Restrepo is a biologist with a PhD in plant pathology. When writing her thesis on cassava at the start of the 2000s, she spent some time in Montpellier, thanks to a partnership between the International Centre for Tropical Agriculture (CIAT) and IRD.



## The limitations of conservation incentives



Meeting between farmers and hydroelectricity project staff about establishing payments for environmental services - Madagascar  
G. Serpantié © CIRAD

Economic incentives for conservation have proved less effective than expected, says Driss Ezzine de Blas, a socioeconomist with CIRAD who looked into their grey areas in a special issue of the journal *Ecological Economics*.

Payments for environmental services (PES) rarely achieve the desired behavioural changes. The fact that they are compulsory may also adversely affect the motivation and long-term independence of the intended beneficiaries. In other words, it undermines their efficacy.

The researcher and other international experts stress that incentives should be part of a wider institutional, economic and cultural framework. They also link the socioecological demands of these incentives with farmers' psychological processes. They recommend certain rules of good practice to make such policies more effective: study intrinsic motivations within a region, adopt a participatory approach, and foster reciprocity.

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# Partnerships, a guiding principle for CIRAD

Working in partnership has always been at the heart of CIRAD's operations. Along with its scientific output, this is the second vital lever for sustainable development, a vision that CIRAD has always defended.

Over time, CIRAD has forged strong, long-lasting links with institutions in the global South and built a global network of partners and of twelve regional offices, through which it works with more than 100 countries. As ever, its geostrategic priorities continue to be Africa and the Mediterranean.

CIRAD is continuing to prove its commitment to Europe, by participating in building European initiatives and making an active contribution to European cooperation policy, particularly with Africa.

## | WORLDWIDE |

Environment and sustainable development

## CIRAD, IRD and UNEP sign a cooperation framework agreement

CIRAD, IRD and the United Nations Environment Programme (UNEP) signed a framework agreement for scientific cooperation during the One Planet Summit in Nairobi (Kenya). This multidisciplinary agreement concerns the major global environment and sustainable development challenges.



The third edition of the One Planet Summit was held as a side event to the fourth session of the United Nations Environment Assembly, from 11 to 15 March 2019, and enabled CIRAD, IRD and UNEP to sign a framework cooperation agreement. At the heart of this agreement: conservation, natural resource protection and biodiversity preservation, which are key challenges within the United Nations Sustainable Development Goals (SDGs).

The agreement focuses on five areas of cooperation:

- protecting marine and terrestrial biodiversity;
- understanding and managing climate risks;
- acquiring and managing environmental data;
- studying soil degradation and land restoration programmes;
- linkages between environment, society and health.

CIRAD President Managing Director Michel Eddi, UNEP Chief Scientist and Director of the Science Division Jian Liu and IRD President Jean-Paul Moatti, at the signing of the framework agreement in Nairobi © IRD/Cécile Bégard

One Planet Summit

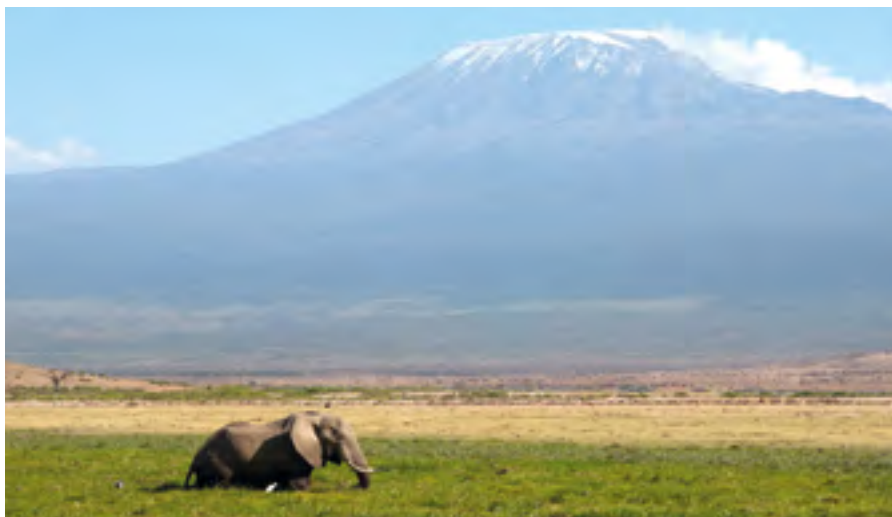
## CIRAD is working for the climate and environment in Africa

CIRAD took part in the One Planet Summit in Nairobi, Kenya, on 14 March, instigated by France and in partnership with the World Bank and the United Nations Secretariat.

The summit, which was intended to keep the fight against climate change at the top of the political agenda, brought together representatives of both States and civil society, along with research organizations.

At the event, CIRAD, which is heavily committed to the climate and environment in Africa, signed two general agreements for scientific cooperation:

- one centring on the environment, with IRD and the United Nations Environment Programme (UNEP);
- the other concerning training for junior researchers, with the Kenyan Ministry of Education.



Elephant searching for food during the dry season in a wetland area of Amboseli National Park (Kenya), at the foot of Mount Kilimanjaro. F. Ribeyre © CIRAD

## | FRANCE |

### NumBA, the tropical agronomy digital library, is up and running

NumBA, the fruit of a partnership between the French national library (BnF) and CIRAD, is the seventh "Gallica marque blanche" digital library. This digital cooperation scheme enables CIRAD to benefit from the infrastructure and functionalities of Gallica, the BnF digital library, while giving its library its own graphic identity. It serves to share the investments made by the BnF and to enrich the national digital heritage. NumBA provides free online access to more than 3000 rare, often unique documents [texts, maps, images, photographs], which shed light on the switch from a technical, educational approach to agriculture in the French ex-colonies to a scientific approach in favour of development in the global South.



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### French agricultural research and CGIAR reinforce their collaboration on agriculture, food and climate

The French Ministry of Higher Education, Research and Innovation hosted CIRAD, INRA, IRD, IRSTEA, Agreenium and CGIAR on 22 March 2019 at the meeting of high-level officials of the French Commission for International Agricultural Research (CRAI). The event saw the signing of a joint declaration to reinforce scientific collaboration between the organizations, the culmination of a reflection operation

launched in June 2018.

The declaration aims to ensure greater synergy of scientific expertise between French organizations, CGIAR Research Centres, and national research systems in the global South, on three thematic areas of vital importance for development:

- agriculture and climate change
- agroecology
- nutrition and sustainable food systems.



### "MAK'IT is an intellectual booster for accelerating transitions towards the sustainable development goals"

Montpellier Advanced Knowledge Institute on Transitions (MAK'IT), which is supported by CIRAD, is one of the key projects at Montpellier University of Excellence (MUSE). By bringing a dozen or so experts together for several months to look at a specific issue, MAK'IT is intended to be a collective intelligence forum, to accelerate transitions in the fields of health, the environment, agriculture and food. This advanced

knowledge institute was officially launched in Montpellier on 7 March. The results obtained by the first scientific pilot group, which worked on the circularity of food systems, were presented at the international event, which was attended by people from ten countries: Brazil, China, France, Japan, Morocco, the Netherlands, Republic of Guinea, Senegal, South Africa and Spain.

### ANSES and CIRAD strengthen their scientific collaboration on health

On 26 February, at the Paris International Agricultural Show, ANSES and CIRAD signed a five-year framework partnership agreement. The two organizations are thus strengthening their collaboration to improve knowledge of pathogens, pests and vectors in the fields of animal and plant health, and food.

In particular, the agreement centres on characterizing pathogens and pests, developing methods for their monitoring and epidemiological surveillance, working together on international health monitoring, improving the identification and characterization of vectors and pests, reducing the use of antibiotics in livestock farming, and preserving the diversity of biological resources.

The two players have committed to work for sustainable farming and health systems (One Health), at the interface between humans, animals and ecosystems  
© P.-Y. Le Gal, CIRAD



## | EUROPE-AFRICA |

In this multi-functional landscape in South Africa, farmers can harvest all sorts of natural and cultivated products. Such landscapes are good examples of adaptation to and mitigation of climate change  
E. Torquebiau © CIRAD



Agricultural cooperation  
is at the heart  
of relations between  
the European Union  
and the African Union

**CIRAD economist Bruno Losch\* was heavily involved in the Task Force Rural Africa, created by the European Commission in 2018. Its final report was discussed at a conference of Ministers of Agriculture from the African Union and European Union in Rome in June 2019. A policy declaration and an action plan were adopted with a view to the creation of a new Africa-Europe Alliance for Sustainable Investment and Jobs. In particular, there are plans to set up a joint investment platform to foster agricultural enterprise in Africa.**

Four strategic areas for action proposed by the task force, split into six key operations, were validated.

**Adopting a territory-based development approach, to create income and jobs.** In this way, the immediate needs of communities, farmers, firms, and local and regional institutions will be met more effectively, particularly in medium-sized and small towns and rural zones in Africa.

**Managing land and resources sustainably, to respond to the challenges posed by climate change.** The task force recommends supporting sectoral policy and territorial dynamics in this field, associating local players and users, for instance by encouraging sustainable, resilient food systems.

**Transforming African farming long term.** It is essential to give priority to family farmers and technical systems tailored to global change, such as agroecology.

**Developing African industry and food markets.** The task force advises facilitating access to funding and cooperation tools.

The European Commission will be monitoring and implementing several of these actions, including a twinning and exchange programme between agricultural organizations in Europe and Africa, an AU-EU platform for agri-business, and innovation centres to support African agro-entrepreneurs.

Josefa Sacko, Commissioner for Agriculture of the African Union Commission, and EU International Development Commissioner Neven Mimica agree on the need to “*work hand in hand*” and “*come together... for a positive rural transformation, and an inclusive and sustainable agriculture and agrifood sector*”.

\* Researcher and Visiting Professor at the University of Western Cape, South Africa



## | AFRICA |

## France was centre stage at the fifth edition of SARA in Ivory Coast

The Salon international de l'agriculture et des ressources animales (SARA) was held from 22 November to 1 December in Abidjan (Ivory Coast). CIRAD and AFD welcomed visitors on a shared stand in the France Pavilion, and contributed to a series of round tables on the topic of sustainable, innovative farming systems that are also resilient to climate change.

No fewer than 300 000 visitors and more than 700 exhibitors were in Abidjan for the Salon international de l'agriculture et des ressources animales (SARA), for which this year's theme was "Smart agriculture and technical innovations: which perspectives for African agriculture?". For this fifth edition, France was centre stage, with a pavilion housing more than 60 exhibitors and 85 firms.

CIRAD and AFD welcomed a large number of visitors, including professionals, academics and researchers, and dignitaries from both Ivory Coast and France, on a joint stand for which the theme was "Investing and innovating for sustainable family farming". They also took part in a series of conferences and round tables that allowed participants to debate the experiences and initiatives of players in the field as regards sustainable agriculture and the agroecological transition in West Africa. The week was marked by two days in particular: the "France" day, for which the focus was on the agroecological transition and innovations in terms of agriculture and agrifoods, and the day organized by the Ivorian Ministry of Water and Forests, for which the topic was supporting zero-deforestation agricultural value chains.

Sylvie Lewicki and Patrice Grimaud, CIRAD Regional Directors for West Africa - Dry Zone and West Africa - Forest and Humid Savannah, welcome Jean-Baptiste Lemoigne, French Secretary of State to the Minister for Europe and Foreign Affairs, on the AFD-CIRAD stand. © A. Garnier



## A WORD FROM A PARTNER



**Kone Siaka,**  
Director of the  
Ecole supérieure  
d'agronomie  
(ESA), Abidjan

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In Ivory Coast, CIRAD is working on the future for cocoa and the development of agroforestry, thanks to a fruitful partnership with the Institut national polytechnique Félix Houphouët-Boigny (INP-HB), a public higher education, research and development establishment. Dr Kone Siaka, Director of the Ecole supérieure d'agronomie (ESA) in Abidjan, is one of the main players.

### What links does INP-HB have with CIRAD?

In 2012, INP-HB signed a general agreement with CIRAD that applies to all its colleges. Since then, we have been working together to offer the best possible training for future managers from our agricultural sector. We also conduct joint R&D projects and appraisals for professionals.

### What topics are you working on?

We are working on different types of production and on the sustainability of our farming system, which is inextricably linked to forest management. Over the past 50 years, Ivory Coast has lost 90% of its forests, notably due to clearing in order to plant cocoa. We are hosting CIRAD's Bruno Hérault, who is conducting a project on forest management (ForestInnov) in association with the Ecole supérieure d'agronomie and the Société de développement des forêts (Sodefor). We have also worked with François Ruf on certification in the cocoa sector, and with Michel Fok on the cotton value chain in Ivory Coast.

### 2020 marks a turning point, as INP-HB will become a CIRAD partner in its own right, through the Cocoa4Future project. What will this mean on the ground?

The project is funded by the EU DeSIRA – Development-Smart Innovation through Research in Agriculture – initiative. It aims to make cocoa farms in Ivory Coast and Ghana less vulnerable while preserving the environment and identifying drivers of socioeconomic sustainability. ESA will be hosting two CIRAD researchers, one of whom is Patrick Jagoret, for five years, and working with others based in Ghana.

### BIOGRAPHY

Dr Kone Siaka studied for his PhD at CIRAD and INRA, under the co-supervision of Michel Fok, working on the categorization and assessment of various scenarios for the conclusion of the Doha cycle for cotton value chains in West and Central Africa.

## | AFRICA |

**CIRAD signs up to support small-scale fish farming**

Putting fish farmers at the heart of the co-construction of innovative solutions is the shared goal of CIRAD and the NGO APDRA-Pisciculture Paysanne. The two organizations signed a framework agreement on 2 March at the Paris International Agricultural Show, setting out the terms of their common approach to applied research for small-scale fish farming.

CIRAD and APDRA have been supporting small-scale fish and fish-rice farming systems since 1990 in sub-Saharan Africa,

but also in other parts of the world. One innovative aspect of this support is the co-construction of systems with producers, which enables them and their families to appropriate those systems better. To satisfy their food requirements and diversify their sources of income, fish farmers are encouraged to adopt an agroecological approach that will make their operations more sustainable and improve their capacity to adapt to climate change.



CIRAD President Managing Director Michel Eddi and APDRA President Claire Gsegner signed a framework agreement on 2 March 2019 © S. Della Mussia, CIRAD

## | MEDITERRANEAN |

**The MASSIRE project, innovating for better water resource management in North Africa**

In some parts of Morocco, Algeria and Tunisia, rapid agricultural expansion is increasing pressure on water resources and threatening the sustainability of farming. *“Contributing to improving water efficiency for agricultural purposes, especially collective uses, and facilitating coordination between stakeholders in order to share the resource between different uses and preserve its quality is one of the commitments CIRAD has made in its new strategic vision”*, says Stefano Farolfi, a water management expert at CIRAD.



© M. Kuper, CIRAD

This is also the aim of the MASSIRE project, which is intended to select innovations with high potential for water management and assess the conditions for their adoption in North Africa. The project was launched in early May in Rabat (Morocco), and is coordinated by CIRAD and implemented with its partners in North Africa, with funding from the International Fund for Agricultural Development (IFAD).

## | BRAZIL AND SOUTHERN CONE COUNTRIES |

**CIRAD has signed an agreement to cooperate on water resources with FUNCEME**

FUNCEME's Eduardo Martins (left) and CIRAD's Sylvain Perret (right) sign the cooperation agreement © CIRAD

CIRAD and FUNCEME, the Meteorology and Water Resource Centre in Ceará state, Brazil, signed a scientific and technical cooperation agreement in April, covering the fields of water resources, agronomy and the environment. The agreement also includes research activities in partnership, and exchanges of researchers, students and technicians. The two organizations are already involved in a France-Brazil-Africa project on the joint evolution of water resources and society, which includes student exchanges.

**CIRAD and IPEF renew their cooperation on forest science**

In April, CIRAD and IPEF, the Brazilian Forestry Science and Research Institute, signed a rider renewing their agreement for scientific cooperation in the field of forest science, notably for applied ecology, silviculture and forest product studies. The rider specifically covers their collaboration on the Euclux programme, a project involving several teaching and research organizations in Brazil, France and the USA, to monitor carbon, water and nutrient fluxes within planted eucalyptus forests.

Since 2009, CIRAD has prioritized a novel way of operating overseas: participating in "platforms in partnership" (dPs), a tool it developed and has implemented with its partners.

This reaffirms its commitment, through medium- and long-term contracts, to research, innovation and training platforms built and managed jointly with its partners.

CIRAD is currently a member of more than twenty platforms, to which it assigns researchers, which each involve up to thirty partner institutions.

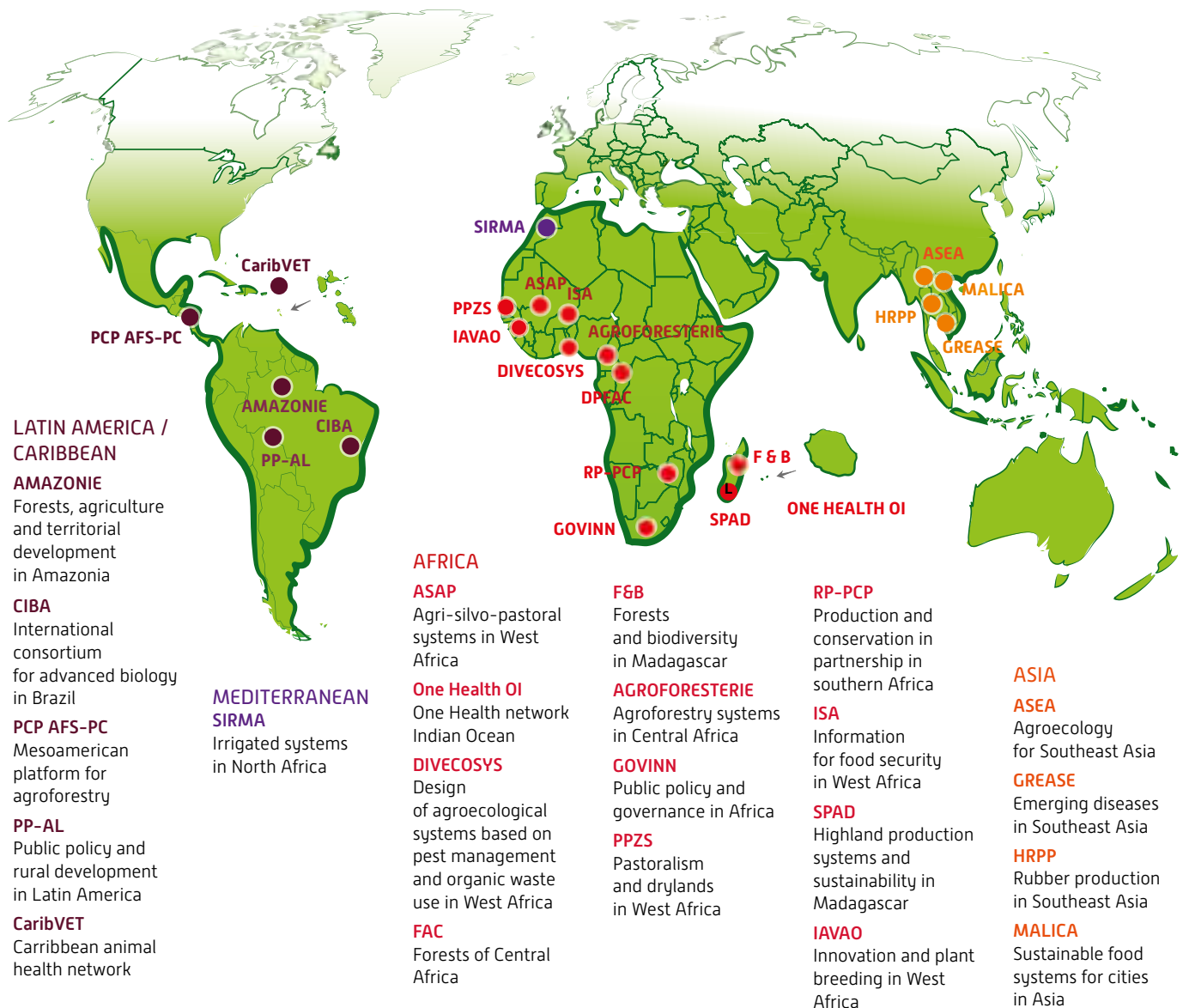
Each dP aims, through research, innovation and training, to address a development challenge chosen by all the partners involved for its local



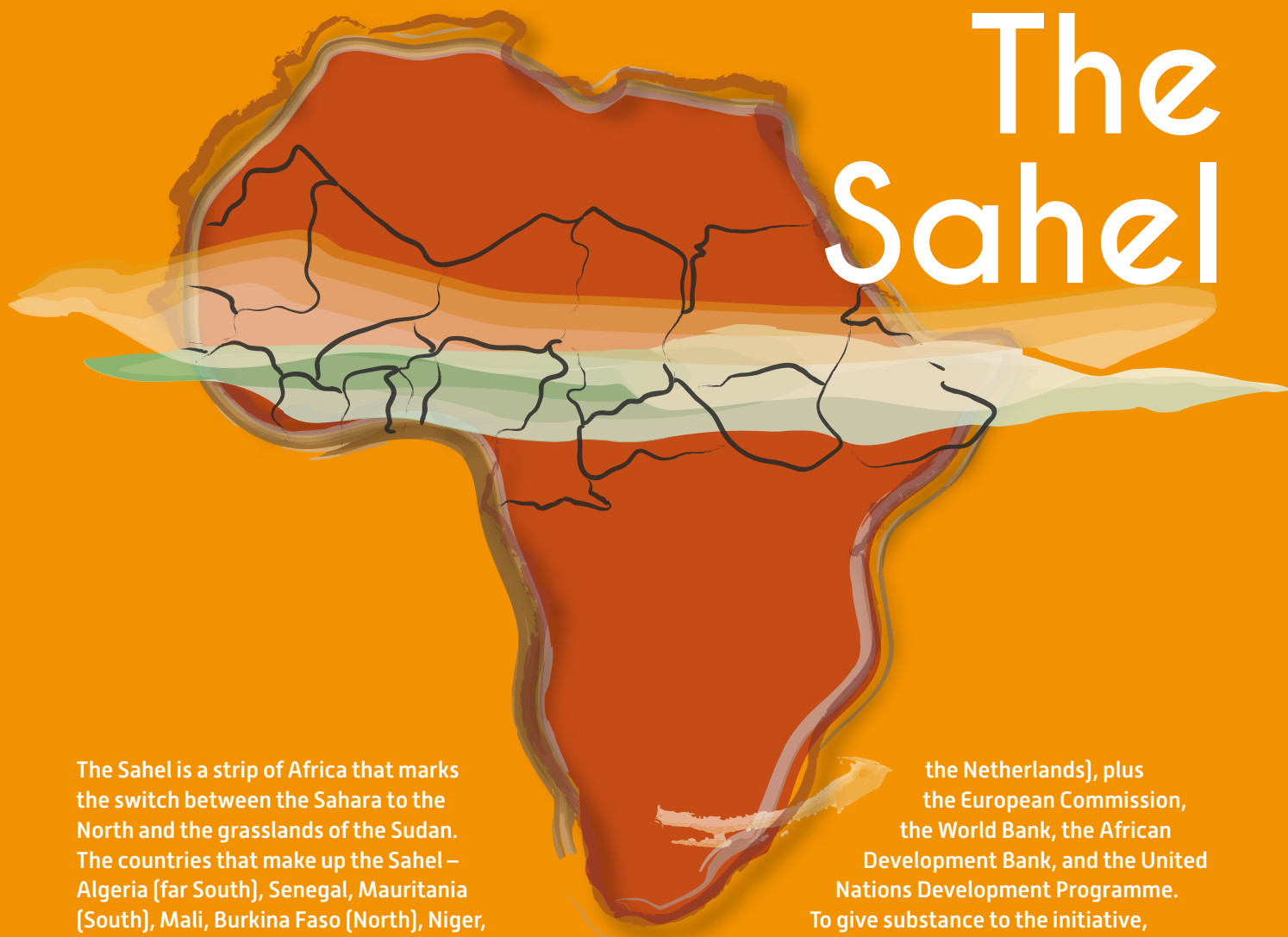
relevance and its contribution to regional or global issues. The platforms are regularly audited by independent committees whose members and terms of reference are chosen by the partners.

CIRAD has made a long-term commitment to these platforms, in line with its remit to contribute to sustainable development through knowledge generation and capacity building.

The network of partners the dPs represent also serves to promote an international scientific community within global research, covering the entire intertropical zone, including the French overseas regions.



# Focus: The Sahel



The Sahel is a strip of Africa that marks the switch between the Sahara to the North and the grasslands of the Sudan. The countries that make up the Sahel – Algeria (far South), Senegal, Mauritania (South), Mali, Burkina Faso (North), Niger, Nigeria (North), Chad (centre), Cameroon (North), Sudan (centre), and Cape Verde – face huge challenges: population pressure, climate change, food insecurity, and rising conflict. In this transitional zone, between the desert and the humid Tropics, two in three people live in rural areas.

The Sahel Alliance was founded in 2017, to ensure more wide-reaching, effective work in the region. This international cooperation platform currently comprises eight countries (France, Germany, Italy, Spain, the United Kingdom, Denmark, Luxembourg,

the Netherlands), plus the European Commission, the World Bank, the African Development Bank, and the United Nations Development Programme.

To give substance to the initiative, national agricultural research organizations in the Sahel countries, backed by CIRAD, signed the Ouagadougou Declaration in 2018, with a view to building a programme and a policy framework aimed at making an active contribution to achieving the aims of the Sahel Alliance.

What follows is our view of the prevailing issues and the agricultural and food potential of this region, which was chosen as the topic for the CIRAD-AFD joint stand and a conference at the 2019 Paris International Agricultural Show.



## “To develop the Sahel sustainably, the constraints must be turned into opportunities”

Faced with climate change, in a context of consistently high population growth, the countries of the Sahel are increasingly exposed to socioeconomic and environmental constraints. An interview with Sylvie Lewicki, IRAD Regional Director for West Africa - Dry Zone, looking at these issues and CIRAD's work in the region.

**In the Sahel, people depend on rainfed agriculture and pastoralism, two sectors at the heart of CIRAD's operations. What challenges are central to those operations?**

Rainfall levels in the Sahel are very low to moderate at best, the land there is fragile, agricultural soils are being degraded, and growing competition for resources is threatening the peaceful coexistence of communities. Climate change is making matters worse.

However, the Sahel is also a land of opportunities, capable of rising to these challenges. To develop the Sahel sustainably, we need to work to turn the constraints into opportunities!

By promoting traditional farming practices and enhancing them with innovations produced by research, based on the principles of agroecology, the Sahel countries can ensure that sus-

tainable agriculture prospers, and provide young Africans with jobs.

**What are the key development drivers on which CIRAD is focusing its efforts?**

The first is education and training for the 380 million young people who will enter the job market by 2030. The challenge for the Sahel and for sub-Saharan Africa as a whole will be to provide them with jobs and income. This is why training is central to CIRAD's concerns.

Another key driver is hydro-agricultural infrastructure and irrigated farming. Contrary to what might be assumed, water is present in the very heart of the Sahel, with some large rivers. Managing water helps to stabilize and intensify agricultural production and diversify the crops grown, which is vital for local people's food and nutrition security.

CIRAD is focusing its efforts on agroecology, to improve agro-silvo-pastoral systems. But it is

also looking to foster high added value sectors and markets, particularly the products of pastoralism, such as milk. Land tenure is another issue for CIRAD, including managing conflict between sedentary and nomadic herders.

Animal health issues are also crucial. It is important to note CIRAD's successes in terms of controlling trypanosomiasis and peste des petits ruminants, which has enabled the development of livestock farming in sub-Saharan Africa. With the recent eradication of the tsetse fly in the Niayes region of Senegal, for example, an increase in cattle production equivalent to 2.8 million euros per year is expected.

**From an institutional viewpoint, how is CIRAD involved in the region?**

The Sahel is currently the world region with the highest number of expatriate CIRAD staff members, with some forty senior scientists posted there. This zone is a priority for France, but also for Europe and the international community as a whole. In the Sahel, CIRAD works with long-standing partners: the Institut d'Économie Rurale (IER) in Mali, the Institut de l'Environnement et Recherches Agricoles (INERA) in Burkina Faso, and the Institut Sénégalais de Recherches Agricoles (ISRA) in Senegal. Together they are seeking to meet the rural development and food security objectives set by the Sahel Alliance\*. CIRAD and its partners in the Sahel recently signed the Ouagadougou Declaration for agricultural research in the Sahel.

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\* The Sahel Alliance, founded in 2017 on the initiative of France and Germany, comprises twelve donors. It works in Burkina Faso, Mali, Mauritania, Niger and Chad.



Village in Burkina Faso  
© Denis Cordier, Adobe Stock

## Sahel: supporting agricultural development and adaptation to climate change



The Sahel is vulnerable to crises and insecurity, and is one of the world's poorest regions. In this transitional zone between the desert and the humid Tropics, two in three people live in rural areas. In view of the climate hazards, how can agriculture innovate and develop in order to satisfy the vital requirements of the region's growing population?

The Head of the village of Ndiadiane, who grows millet, groundnut and cowpea in an agroforestry system, with his family  
C. Dangleant © CIRAD



The Sahel was centre stage this year on the CIRAD-AFD (Agence française de développement) stand at the Paris International Agricultural Show, from 23 February to 3 March. The stand comprised an informative and entertaining space on agriculture in the Sahel, an area to welcome and talk to visitors and meet and inform professionals, partners and institutional and political representatives from all backgrounds, and an area dedicated to recruitment, learning and training at CIRAD.

The Sahel was also the topic of a conference organized by CIRAD and AFD at the Show: "Sahel, a land of agricultural opportunities and challenges". The conference attracted institutional players, researchers and field actors keen to discuss research, investment and innovations in favour of agriculture in the Sahel. It comprised a session on agriculture and pastoralism in the Sahel and the conditions for and drivers of development in the region, followed by eyewitness accounts from the field, and a round table on "innovation for people in the Sahel: what is the potential in terms of agriculture?".



Milk delivery in a Fula camp in northern Benin  
© G. Duteurtre, CIRAD



### West Africa: traditional dairy products are under threat from imports

The wide variety of West African dairy products is a cultural asset that is currently under threat. The reason: growing urbanization, the lack of public support for local production chains, and especially international competition from cheap milk powder imports. "Cheap milk powder blends enriched with vegetable fat compete with local milk", says Guillaume Duteurtre, an agroeconomist with CIRAD studying the impact of international trade on African dairy traditions. "They are sold as 'milk powder', even though they are not strictly a dairy product. At the same time, many

traditional products are no longer sold in towns. This is the case, for example, of fermented milk, solid and clarified butter and some traditional cheeses. The actors in the chain need to organize themselves to promote this dairy heritage and to protect it against milk powder imports." That dairy tradition could drive the region's economic development. This work was presented at the "Milk, driver of development" symposium organized in Dakar in June 2019 by CIRAD, INRA and ISRA.

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## Agroecology is being used to improve food quality in the Sahel



Senegal and Ethiopia are implementing an ambitious project aimed at increasing the amount of micronutrients in basic foodstuffs, through the use of agroecological practices. *“The idea is to monitor three essential micronutrients – zinc, iron and vitamin A – from the field to the plate, in two commonly consumed cereal crops, millet and teff, which will be associated with legumes, such as peas in Ethiopia and cowpeas in Senegal, and orange-fleshed sweet potato”,* says Jean-Michel Médoc, an agronomist at CIRAD and coordinator of the project. *“The aim is also to propose agroecological cropping systems, associating varieties that are naturally high in micronutrients with organic fertilization practices”.* The idea is to contribute to addressing malnutrition issues affecting mothers and their children. The experiment will run until 2021 and could eventually benefit other countries in the Sahel.

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Traditional Ethiopian dish with teff pancakes G. Trébuil © CIRAD

## Senegal: the many benefits of agroforestry



Agroforestry system in the Senegal groundnut basin, where millet, groundnut and cowpea are the dominant crops C. Dangleant © CIRAD



In the Sahel, it only rains for three months a year. During this short period, rural populations grow their food for the year. In view of this insecurity, agroforestry’s multiple advantages are a blessing: adaptation to climate change, improved soil fertility and even crop protection against pests. In Senegal, *Faidherbia albida*, a tree that is emblematic of the Sahel, has all the above advantages and more. It provides local people with wood, supplies fodder for livestock during the dry season, fixes atmospheric nitrogen, and regulates attacks from pests, including millet head miners, as it acts as a refuge for their predators, as shown in recent studies by CIRAD.

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**PUBLICATION**  
**Pastoral landscapes in the Sahel: a carbon balance with unexpected potential for climate change mitigation**  
 Perspective 52, November 2019

In the Sahel, pastoralism is accused of emitting excessive amounts of greenhouse gas, yet a study in Senegal has shown that pastoral landscapes can actually have a neutral carbon balance: emissions from animals are offset by carbon sequestration in soils and plants. These findings, obtained using the ecosystem

assessment method, suggest that current standards for calculating feeding behaviour and methane emissions from ruminant digestion should be revised downwards.

<https://doi.org/10.19182/agritrop/00082>

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# 2019 Indicators

This section analyses CIRAD's activities, based on indicators.

Those indicators tally with the 2019-2023 Contractual and Performance Objectives and CIRAD's main objectives set out in its 2018-2028 Strategic Vision:

**Science ambition**

Scientific priorities with an impact on development

**Partnership ambition**

Building strategic partnerships

**Training ambition**

Establishing a novel offer in terms of skill building

**Innovation and impact ambition**

Establishing the conditions for innovation with impact



CIRAD's strategic documents have different scopes, but also levels of implementation that concern all of the operational levels of the establishment: from the whole institution to the individual research units and departments. The first document, which sets out the key issues of strategic input and the establishment's scientific and partnership position, is the Strategic Vision, drafted for 10 years and revised every five years. The 2019-2023 Scientific and Partnership Strategy Objectives (SPSO<sub>2</sub>) document translates these key issues into stra-

tegic priorities for the establishment for the coming five years and, finally, the Multi-Annual Letters of Objectives (MLOs) define the contributions required of each unit and department for the period. The Contractual Objectives supplement the SPSO<sub>2</sub> and formalize CIRAD's commitments and objectives, negotiated for five years with its line ministries (<https://www.cirad.fr/en/who-are-we/our-strategy>). This annual report is thus set within a new framework of reporting to the line ministries.

## THE CONTRACTUAL OBJECTIVES



*[in French]*

The indicators to monitor progress on the SPSO<sub>2</sub> were negotiated with the line ministries in 2019 with a view to updating CIRAD's Contractual Objectives.

These negotiations were conducted at several workshops (March to October 2019) involving the line ministries (MESRI and MEAE), but also the ministries concerned by CIRAD's activities (Agriculture and Food, Overseas Regions, and Economy and Finance). The document follows the plan of the Strategic Vision: four key ambitions supported by a dedicated resources policy. It describes the outputs expected and sets targets for certain indicators. The number of indicators has been halved (8) for greater efficiency. They have been reassessed according to criteria of utility and interest, evolution and dynamics, output capacity and achievement of objectives. For this new version of the Contractual Objectives, these indicators, indexed on the base year 2018, are nevertheless supplemented by a range of deliverables (almost 50) that will be produced over the completion period for these objectives (2019-2023).

At the request of the line ministries, the key thematic fields (KTFs) were aligned with the Sustainable Development Goals (SDGs) in order to clarify the contribution expected of everyone involved. CIRAD's activities mostly contribute to a limited number of SDGs, some of which are nevertheless fully consistent with its mandate (12: Responsible Production and Consumption, and 17: Partnerships to achieve the Goal).

The negotiations with the line ministries were regularly presented to CIRAD's governance bodies, the Science Council and the Board, but also to internal bodies: the unit and support service management committee and the new Works Council (CSE).

The document was unanimously adopted at the Board meeting in December 2019, signed by the line ministers and published on CIRAD's website (<https://www.cirad.fr/en/who-are-we/our-strategy>).

## THE SCIENCE AMBITION

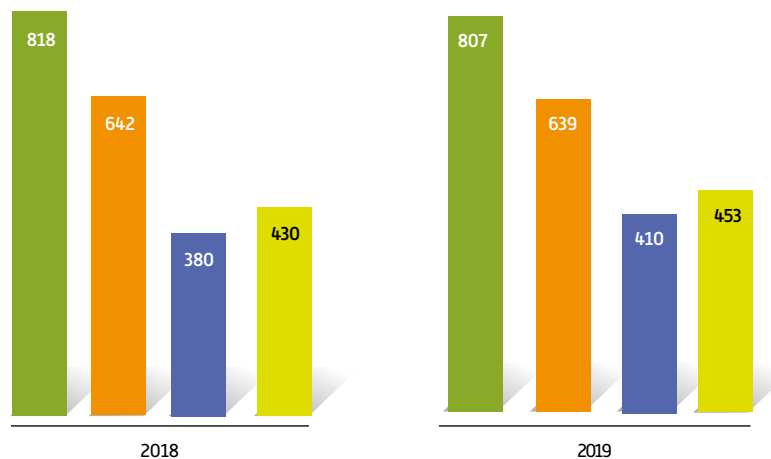
CIRAD's scientific priorities stem from the commitments made in its Strategic Vision and are now translated into six cross-cutting key thematic fields that encompass new functions: facilitation, planning, visibility and reporting.

Scientific output is one of the permanent indicators (indicators 1 and 2). The 2019 results show a volume of publications and co-publications similar to that in 2018, illustrating the stability of CIRAD's scientific output, particularly that produced with its research partners.

Since the signing of the Berlin Declaration in 2016, CIRAD has been fully committed to a policy of free open access to its outputs (indicator 1).

Thus, in 2019, more than 110 000 resources were available on Agritrop, CIRAD's open archive platform (<https://agritrop.cirad.fr>), with 554 000 consultations and more than 1 900 000 downloads of scientific documents.

### Indicators 1 and 2. Scientific output



Indicator 1. Peer-reviewed articles, with or without impact factor, including open access articles

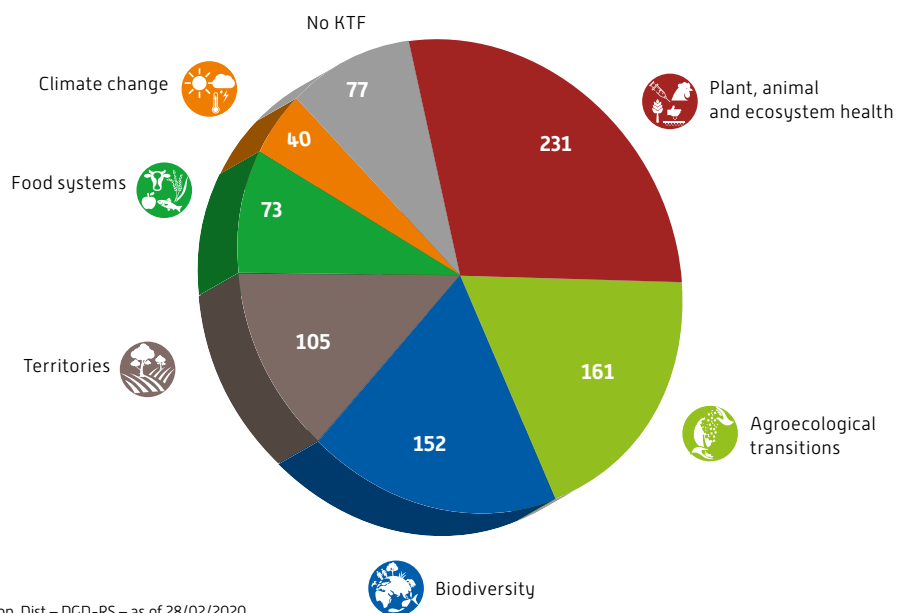
Peer-reviewed articles, with or without impact factor      With impact factor      Articles in peer-reviewed journals with at least one open-access version

Indicator 2. Number of peer-reviewed articles, with or without impact factor, co-published with partners in the global South

Source : Agritrop. Dist – DGD-RS – état au 28/02/2020.

In 2019, the key thematic field "Plant, animal and ecosystem health" boasted the largest number of peer-reviewed articles (231 articles), followed by the KTFs "Agroecological transition" and "Biodiversity" (161 and 152 articles respectively), then "Territories" (105), "Food systems" (73) and, finally, "Climate change" (40). A total of 77 articles did not belong to any thematic field.

### Distribution of publications by key thematic field



Source : Agritrop. Dist – DGD-RS – as of 28/02/2020

## THE PARTNERSHIP AMBITION

In 2019, geographical mobility of CIRAD staff members showed an overall decline in the number of CIRAD researchers abroad and in the French overseas regions (DOMs), to almost 310 full-time equivalents (FTEs). This presence remained predominant and stable for the DOMs (121 FTEs, or almost 40%) and increased slightly for West Africa (99 FTEs, or 33% of staff) (indicator 3). These two major regions account for almost 3/4 of our overseas presence. The most notable decline concerns Asia and Latin America, with respectively -5 FTEs and -4.5 FTEs in 2019 in relation to 2018. The targets set are 335 FTEs present in the field, alongside our partners, with ongoing efforts for the African continent.

The number of platforms in partnership (dPs) was reduced to 22 in 2019, with twelve located in Africa and the Indian Ocean, five in Latin America, four in Asia and one in the Mediterranean. CIRAD is also present in three international joint laboratories to which it belongs.

Indicator 4 on assignments conducted by broad geographic area will only be produced from 2021, with a new database (updating of information system underway).

**Indicator 3. Number of senior scientific staff members on assignment in 2019 by major geographic area (in FTEs)**

Sub-Saharan Africa	99.2
North Africa	8.9
Asia	29.7
Oceania	1.7
South America	23.9
Central America	14.8
North America	2.75
French overseas regions	120.9
Europe	5.3
<b>TOTAL</b>	<b>307.15</b>

Source: SIRH. DGD-RD.

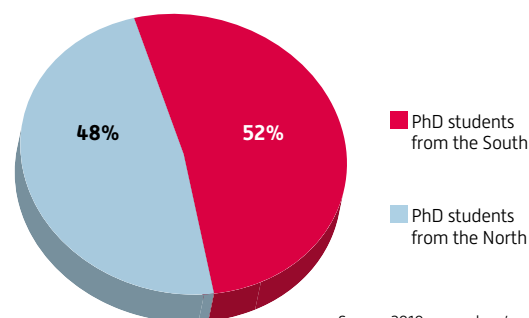
## THE TRAINING AMBITION

The introduction of a new ambition of training in the South, with the South and for the South is one of the key changes in CIRAD's new Strategic Vision in relation to its previous version. This shift is based on the observation that no development is possible for a country without the human capital needed to plan and implement it, which leads most of CIRAD's partners to request its support to help them meet their needs.

The quality of supervision of students remains a key objective for CIRAD. In 2019, CIRAD hosted and supervised 202 PhD students from the South, with a slight fall to 52% of the total (indicator 5). This indicator underpins scientific co-publication (indicator 2).

To meet the many expectations of its partners, CIRAD, for which training is not the primary activity, is strengthening its links with French higher education institutions that target Africa as a priority international development zone. It co-constructs proposals at different levels, especially with colleges belonging to the Agreenium consortium (Montpellier SupAgro, AgroParisTech and ENVT), but also with other academic operators, foremost among which is the University of Montpellier within the framework of the MUSE I-Site.

**Indicator 5. DPhD students supervised by CIRAD researchers**



Source: 2019 researchers' annual report

## THE INNOVATION AND IMPACT AMBITION

The goal of CIRAD's scientific and partnership strategy is to have an effective impact on the political, economic and social processes leading to a lasting change in patterns of production, processing and consumption linked to agriculture and the rural world, for the benefit of producers and people in the countries of the global South. To this end, CIRAD mobilizes knowledge and builds partnerships, which must deliver political, technical and social innovations, in association with and for the benefit of all actors concerned.

CIRAD is actively entering the dissemination phase for the two tools resulting from the ImpresS process (*ex post* and *ex ante*), working at all levels to promote a culture of impact internally, while sharing it with some of its partners. The new Research Impact and Marketing Service (DIMS) is responsible for this process, and has been consolidated in order to develop these construction, monitoring, assessment and learning tools for key projects.

In a global approach, policymakers and civil society must be key contacts for research, but also important targets for CIRAD's outputs. A roadmap establishing the broad lines of a Science and Society dialogue has been produced and validated. It is coordinated by the DGD-RS and the department management teams.

## ALIGNING RESOURCES POLICY WITH THE SCIENTIFIC AND PARTNERSHIP STRATEGY

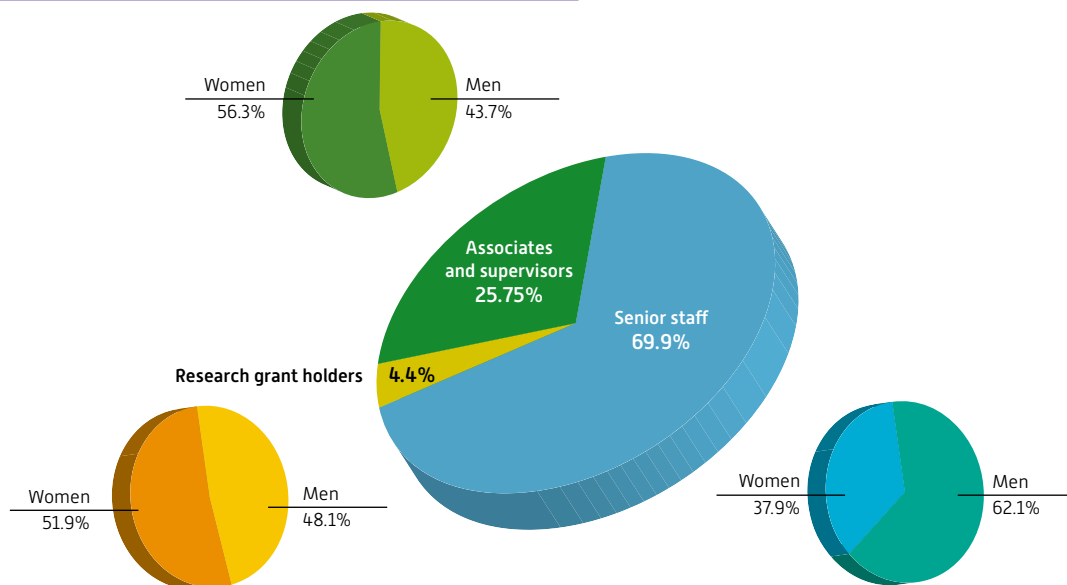
The goal is to develop and implement a financial, human and material resource allocation policy that best suits the scientific and partnership ambitions of the current Contractual Objectives.

The challenge is not simply to ensure the level of resources "required" for CIRAD to conduct its activities. It is also and above all to guide support functions so that they are better aligned with the establishment's strategy.

CIRAD relaunched a dynamic employment policy to build the capacities needed for its scientific and geo-partnership strategy in 2019, with two waves of recruitment. However, efforts to make up for the decline in staff numbers at CIRAD were not successful in 2019. The share of research grant holders, which has reached near parity, has slightly increased, with 4.4% of staff numbers. The share of associates ("collaborateurs") and supervisors

("agents de maîtrise") is steadily decreasing, with a quarter of total staff numbers, of which the majority are women (more than 56%). Progress towards parity is generally slow (43.3% women, 56.6% men), with disparities depending on jobs and categories, especially among senior executives.

**Indicator 6. Distribution of staff members by category (%) and by gender (%)**



Source: SIRH

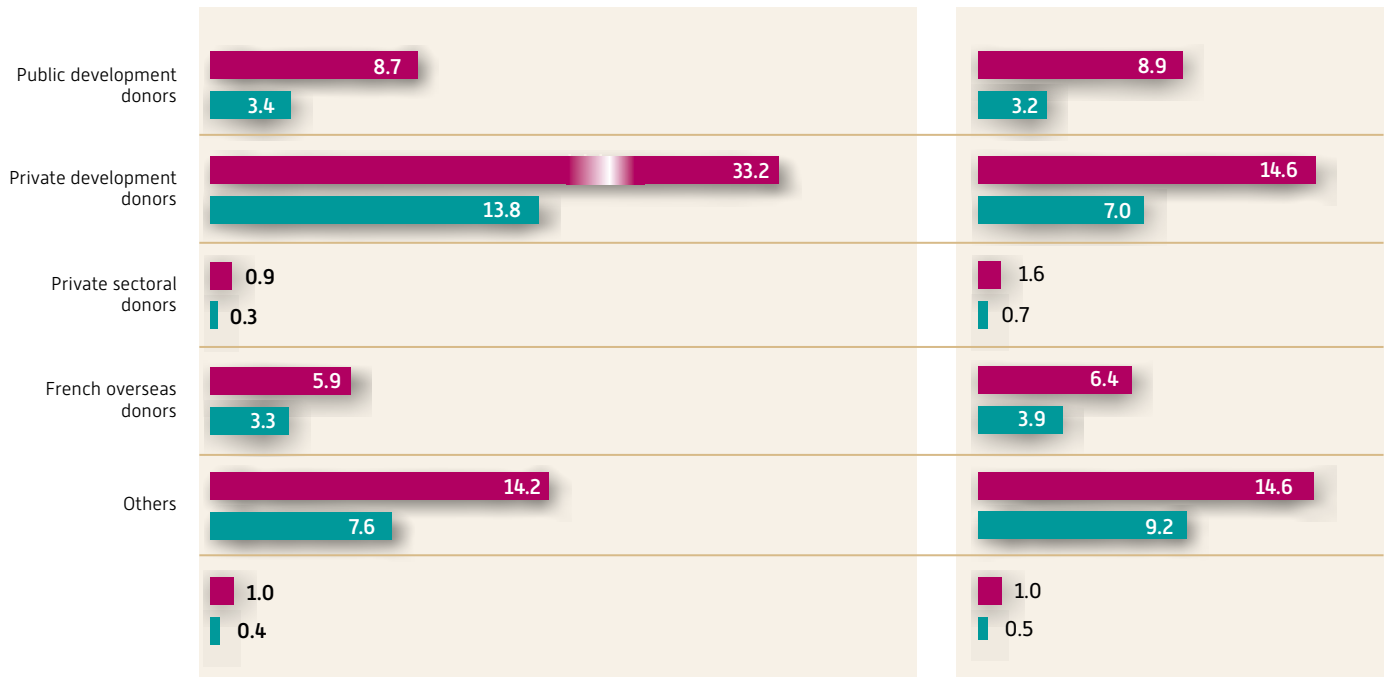
New financial indicators have been selected for the Contractual Objectives. Orders registered primarily concern public development donors, with several DeSIRA contracts (EU DG DEVCO and AFD) negotiated in 2019 (indicator 7). They

are thus very dynamic, with their contribution to the DFI expected to double. As regards outputs, the amount of revenue (€ 47.1M) and the share of DFI (almost 50%), remained stable in 2019, with a substantial contribution from

public development donors and the French overseas regions, in line with existing contracts in the previous year

**Indicator 7. Orders registered for the year (DFI and turnover for project portfolio, M€) by type of donor**

**Indicator 8. Results of contractual activity for the year (DFI and turnover, M€) by type of donor**



■ Turnover ■ DFI

Source: C3 database as of 31 December 2019



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• UPR: Internal research unit • US: Service unit

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