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AGRICULTURAL RESEARCH
FOR DEVELOPMENT



2020 Annual Report

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

CIRAD works with its partners to build knowledge and solutions and invent resilient farming systems for a more sustainable, inclusive world. It mobilizes science, innovation and training in order to achieve the Sustainable Development Goals. Its expertise supports the entire range of stakeholders, from producers to public policymakers, to foster biodiversity protection, agroecological transitions, food system sustainability, health (of plants, animals and ecosystems), sustainable development of rural territories, and their resilience to climate change.

CIRAD was founded in 1984 as a public establishment (EPIC), following a merger of French tropical agricultural research organizations, and is under the joint authority of the Ministry of Higher Education, Research and Innovation and the Ministry for Europe and Foreign Affairs. As such, it supports French science diplomacy operations.

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Adapting in response to crisis

Nobody could have imagined the unprecedented crisis that struck the world in 2020. The Covid-19 pandemic, which triggered a health crisis on a scale never seen before, has turned our lives upside down. It has had a substantial impact on CIRAD, as the reduction, if not the total halt in international travel has prevented us from pursuing some of our operations in tropical and Mediterranean countries. However, thanks to the presence and determination of our expatriate teams, who have remained on the ground alongside our partners, we have been able to sustain our cooperation and continue to fulfil at least some of our contractual activities. All over the world, CIRAD's staff have shown themselves to be both resilient and adaptable. In France, every effort has been made to switch to teleworking, while maintaining those activities that require an onsite presence (in laboratories, greenhouses, etc.). Between lockdowns, our installations, processes and campuses in Montpellier, Nogent-sur-Marne and Paris have been reorganized to allow our staff to return to work safely. That resilience, combined with budgetary support from the State, has enabled us to end the financial year with a positive result.

Counterbalancing the crisis: the European Green Deal and the French research programming act

2020 was a good year in other ways, with a context favouring public development aid and our priority research topics, in both France and Europe. It saw the launch of the European Green Deal, a road map intended to make the European economy sustainable by turning climate and environmental challenges into opportunities. This ambitious policy, backed by substantial resources, is particularly important for CIRAD in that agricultural research and innovation are core issues. In France, the adoption of the research programming act, setting objectives for 2021-2030, also bodes well for CIRAD. The declared ambition is to "fund and assess public research more effectively, make the research professions more attractive, and put science back in an open rela-

tionship with society as a whole". In particular, this means a 25 billion-euro increase in the State budget over ten years, with a million euros added to CIRAD's budget in 2021. We have not seen this type of increase for a decade.

2021: new governance, a packed international agenda, and sustained job creation

I must mention my predecessor, Michel Eddi, who is leaving us after two terms at the helm of CIRAD. The transition scheduled for 2021 has been prepared confidently and calmly. The coming changes to our Board of Directors will allow us to grasp the opportunities open to us in terms of boosting CIRAD's visibility and cementing its reputation, notably through top-level global events such as COP26 (climate), COP15 (biodiversity), and the One Planet Summit, for which CIRAD played an active part in drafting two major proposals, including the creation of a One Health High-level Expert Panel.

This year's unmissable events also include the IUCN World Conservation Congress in Marseilles in May, the Africa-France Summit in Montpellier in October – including specific days organized by MUSE with which CIRAD will be closely associated –, and the UN Food Systems Summit. Within CIRAD, the sustained drive to create jobs should lead to a new rise in staff numbers by late 2021. The marked drop in the number of expatriate staff members calls for strong measures, but the agreement on staff mobility signed recently between management and staff representatives should go some way towards correcting matters. It should trigger a dynamic that will be crucial in fulfilling our remit and implementing our projects. Fingers crossed that it will soon be facilitated by a resumption in international travel!



Élisabeth Claverie de Saint Martin, CIRAD CEO

JANUARY

CIRAD and INRAE renew their Joint Support Unit for International Relations. INRAE President Philippe Mauguin and CIRAD President Managing Director Michel Eddi signed a four-year renewal on 27 January for the CIRAD-INRAE Joint Support Unit for International Relations (UMA-RI). The signing reflects their determination to step up international partnerships between the two research organizations.

FEBRUARY

Climate change: modelling to anticipate impacts

The second edition of the International Crop Modelling Symposium (iCROP2020), held in Montpellier from 3 to 5 February, attracted 400 crop modelling specialists from all over the world. The symposium, organized by CIRAD, INRAE and INRIA with the support of MUSE I-SITE and #DigitAg, was particularly relevant in the current context of global climate change and increased pressure on agricultural production. Participants focused on recent improvements to and new applications for crop simulation models, aimed at supporting agricultural production and food security against a backdrop of climate change.

Agriculture and biodiversity feature at the Paris International Agricultural Show

Biodiversity took centre stage on the joint stand produced by CIRAD and AFD, two major players in research and funding for development in the global South, from 22 to 29 February. Activities, professional meetings and conferences were organized to point the finger at intensive farming, which poses a threat to biodiversity. Visitors were able to discover agricultural models that take account of every element of the living world, to conserve that biodiversity. The stand also welcomed institutional partners and representatives from different horizons with an interest in biodiversity and farming. An area of the stand was devoted to training, partnerships and recruitment.

An alliance against Panama disease

TR4 fusarium wilt is threatening to devastate banana plantations. The disease arrived very recently in Latin America, which accounts for 80% of global dessert banana exports. This incurable disease, also known as Panama disease (tropical race 4), is spreading rapidly, and Cavendish varieties, which provide 100% of export dessert bananas, do not stand a chance. In view of the urgency of the situation, CIRAD

launched the World Musa Alliance at the Fruit Logistica Salon in Berlin on 6 February, in the aim of associating stakeholders in order to find rapid solutions to this threat to banana production worldwide.

Pl@ntnet is here to stay. Ten years after the launch of the collaborative plant identification platform, which has millions of users, its four founder members (CIRAD, INRAE, INRIA and IRD) have set up a consortium to safeguard its future. The consortium, which is led by INRIA, and with which Agropolis Fondation is also associated, is open to new members.

Down with chemical pesticides; European research is taking a stand

CIRAD is one of the signatories of the declaration of intent "Towards a Chemical Pesticide-free Agriculture" formalized by 24 European research organizations at the Paris International Agricultural Show on 23 February. The declaration was driven by INRAE (France) and its German counterparts ZALF and JKI, and intends to pool research efforts aimed at accelerating the agroecological transition in Europe, in line with a shared vision of a synthetic pesticide-free agriculture. CIRAD will be contributing as regards the issue in the ultraperipheral regions, particularly the French overseas regions, where it has already been working on the topic for several years. The declaration cements the establishment of a European research alliance, to contribute to the European Green Deal.

MARCH

Gender-SMART: CIRAD is walking the walk on gender equality

CIRAD has unveiled its institutional action plan for gender equality. The plan is the fruit of the organization's involvement in the EU H2020 Gender-SMART project on gender issues in agricultural and life sciences. CIRAD has committed to make gender equality an integral part of how it operates. It is also including gender in its scientific and partnership strategy. The plan is built around three pillars and 25 objectives, including a gender balance in every profession, and equal pay. Several analysis, training and support operations are already under way.



Agritrop is second in the French institutional open archive rankings. With 28 900 documents indexed by the academic search engine Google Scholar, the CIRAD publications open archive, Agritrop, is second in the French institutional repositories rankings, for the third year running, behind the HAL-Sciences de l'homme et de la Société (HAL-SHS) archive.

JUNE

CIRAD takes position as regards modern genome editing technology. CIRAD considers that public organizations have a responsibility to explore the benefits and limitations of such technology. In a position paper, it reiterates the six principles set out by INRAE [ex-INRA] following the statement issued by the organizations' Ethics Committee in March 2018 in response to a 2016 request from CIRAD and INRA, and introduces the aspect of partnerships.

SEPTEMBER

First sustainable development meetings. CIRAD was a partner in the first edition of the *Rencontres du développement durable* (RDD) from 22 to 29 September, marking the fifth anniversary of the adoption of the UN Sustainable Development Goals. This new annual event is organized by the Institut Open Diplomacy, a public policy think tank with global reach.

The 3P extension in Réunion gets the green light

Eighteen years after the Plant Protection Platform (3P) was built, Éric Jeuffrault, CIRAD Regional Director for Réunion-Mayotte and Indian Ocean, has launched its extension,

Plant Protection Platform © CIRAD



in Saint-Pierre de la Réunion. By the time it opens in 2022, the 3P extension will have almost 1000 m² of brand-new laboratories, 1000 m² of office space and conference rooms, and 400 m² for a biotechnology hall, all built with sustainable development concerns in mind. The inauguration of the construction project, with a budget of almost 13 million euros, was the ideal opportunity for the signing of a new scientific cooperation framework agreement with the other partners in the 3P facility. The extension will have solar panels on its roof, funded by the French State.

Patrick Caron joins the CGIAR Board

CGIAR, a global consortium of research for development centres, is currently being restructured, to build "One CGIAR" capable of playing a greater role in the global orchestration of agricultural research. That reform means an overhaul of CGIAR governance, with the establishment of a leaner board with eight international members, including Patrick Caron. Patrick Caron is a researcher and former Director General in charge of Research and Strategy at CIRAD and is currently Vice President of the University of Montpellier, International Director of MUSE I-Site and President of Agropolis International.

OCTOBER

CIRAD joins RecoNat, the network of French naturalist collections. In doing so, it became a founder member of this new scientific interest group. The network is headed by the Muséum national d'histoire naturelle, and is intended to facilitate access to naturalist data, which are crucial to biodiversity studies. In signing up, CIRAD has confirmed its interest in facilitating access to naturalist collections and their use by the scientific community.

NOVEMBER

#GFOODSEC2020, a digital, interactive conference on food security

For its fourth edition, the International Conference on Global Food Security, scheduled in Montpellier, switched to a digital, interactive format. It was co-organized by CIRAD over three days, from 7 to 9 December. The debate centred on one question: "Achieving local and global food security: at what costs?" and one ambition: to reconcile competing environmental, economic and social objectives in order to achieve the Sustainable Development Goals. To encourage interaction, 20 mini-symposia were organized ahead of the conference.

CIRAD key thematic fields



Agroecological
transitions



Biodiversity



Climate
Change



Food systems



One Health



Territory-based
approaches

Fairer organic farming in Africa

Said Akkif agroecological farm, Brachoua, Morocco



© Riam

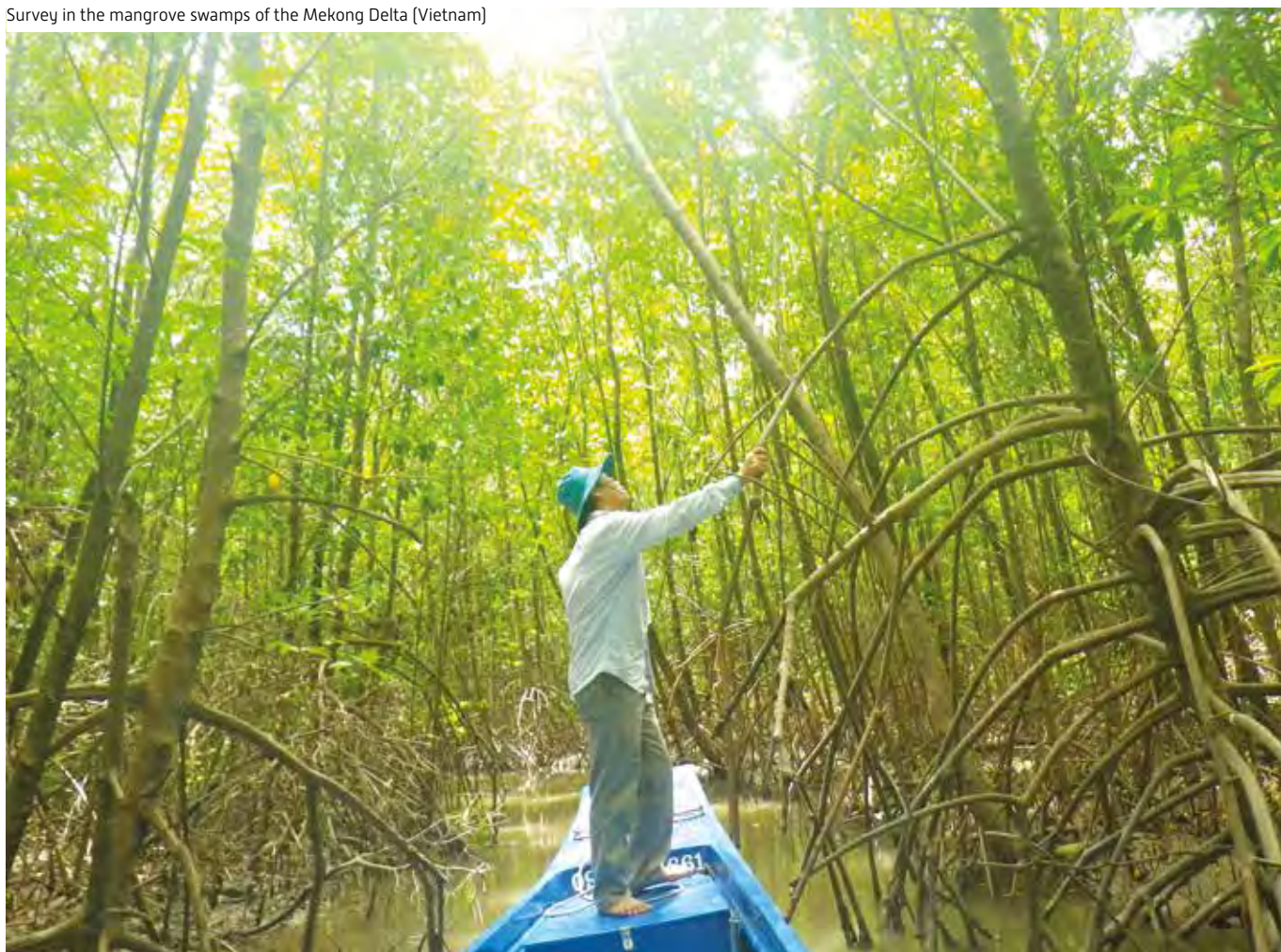


CIRAD is working on action research in Tanzania, Uganda and Morocco as part of a project on institutional innovations for organic agriculture in Africa (IIABA), in partnership with INRAE. Round tables and studies will serve to help the African Organic Network (AfrONet) build new, fairer, more inclusive market models better suited to the social realities of smallholders.

eve.fouilleux@cirad.fr

Mangroves, the guardians of coastal biodiversity, are under surveillance

Survey in the mangrove swamps of the Mekong Delta (Vietnam)



© V. Gond, CIRAD



Scientists from CIRAD have developed an algorithm to ensure effective, automatic monitoring of mangrove stands, whether rehabilitated or natural. They used Google Earth Engine to analyse and synthesize 30 years of Landsat data for southeastern Thailand. It takes between seven and thirteen years for rehabilitated mangrove stands to recover their original rate of photosynthetic activity, and 28 years to reach roughly the same height as natural stands.

valery.gond@cirad.fr

The GFCLim project, working to save the forests of French Guiana



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In response to the vulnerability to climate change of the forests of French Guiana, the GFCLim project, which ran from 2017 to 2019, suggested new strategic directions to resolve issues surrounding competing usage, between wood production and carbon storage. At the project's final seminar in 2020, the researchers involved set out their recommendations: to optimize felling in natural forest areas by increasing the volume of wood extracted per hectare and maintain logging of planted forest areas over several cycles, while working to preserve biodiversity.

geraldine.derroire@cirad.fr

Using drones against mosquitoes that carry disease

Releasing sterile male *Aedes aegypti* mosquitoes using a miniature version of the drone



© F. Bouyer



Just a few more tests and they can be marketed... Two types of drone – with and without parachutes – are due to be used to release sterile male mosquitoes in Montpellier, Réunion and Valencia. The technology is intended to eradicate the mosquitoes that carry disease, and promises to be a much cheaper alternative to releases at ground level. It is based on work by CIRAD entomologist Jérémy Bouyer as part of the Mosquarel project, funded by the European Research Council.

jeremy.bouyer@cirad.f

LIDISKI, scrutinizing animal health on farms in Nigeria

Group discussions with livestock farmers to better understand the epidemiology, socioeconomic impact and local management of PPR and ND



© M. Bordier, CIRAD



More than 20 million households in Nigeria are heavily reliant on livestock, but each year, peste des petits ruminants (PPR) and Newcastle disease (ND) affect their food and economic security. On 5 March 2020 in Abuja, CIRAD and its Nigerian and Italian partners officially launched a system to monitor and control those diseases: LIDISKI (Livestock Disease Surveillance Knowledge Integration). The project, funded by the European Union DeSIRA initiative, centres on training and involving players on the ground in vaccination.

arnaud.bataille@cirad.fr

www.lidiski.org/

Réunion is on its way to a circular bioeconomy



© CIRAD



Between 2018 and 2020, the GABiR project (agricultural management of biomass in Réunion) supported the island in its transition towards a circular bioeconomy. Working in networks, inventorying biomass, co-composting green waste, mapping fodder production and consumption, etc... CIRAD and its partners have launched a series of operations that should allow the island to reduce agricultural input imports and make better use of biomass.

jonathan.vayssières@cirad.fr





COVID-19 SPECIAL

Responsive, committed research

In response to the Covid-19 pandemic, above all, CIRAD has continued to do its job. Conducting research to understand what lies behind zoonoses and how they are transmitted, analysing the reasons for their spread, planning the operations required, and so on.

But that is not all: it has also been quick to promote the One Health approach, in the aim of preventing new global epidemics. This has meant appearing in a variety of media, from *Le Monde* to *The Lancet*.

Almost 75% of emerging infectious diseases are currently transmitted to humans from animals, particularly wildlife. SARS-CoV-2 is the perfect example. As long ago as April, CIRAD President Managing Director Michel Eddi, along with 15 other heads of French research organizations belonging to the French National Research Alliance for the Environment (AllEnvi), signed an op-ed in *Le Monde*. They stressed the role humans play in environmental degradation and highlighted the link between that degradation and pandemics, calling for investment in the One Health approach, which encompasses ecosystem, plant, animal and human health. Then in November 2020, Thierry Lefrançois, who heads CIRAD's BIOS Department, was one of the authors of another op-ed in *Le Monde*, signed by a group of researchers, doctors and veterinarians (see his interview opposite). In the time between those op-eds, several CIRAD researchers spoke publicly to stress the importance of tackling emerging diseases rapidly. Marisa Peyre, a CIRAD epidemiologist, was for instance

heavily involved in drafting a white paper and a policy brief within the framework of the SWM Programme¹. She highlights the need for a coordinated, pragmatic One Health approach, and for participatory monitoring of emerging diseases.

In an opinion paper, Michel de Garine-Wichatitsky and other CIRAD researchers called for the environment to be integrated into governance bodies working to make the One Health approach more operational. To give another example, in June 2020, CIRAD published the first issue of *Science Horizon*², on the topic of "Emerging infectious diseases: the urgency of adopting systemic approaches".

This collective mobilization has borne fruit: late 2020 saw the announcement of the creation of a One Health High-Level Panel of Experts.

1. The Sustainable Wildlife Management Programme (SWM), led by FAO, WCS, CIFOR and CIRAD and funded by the European Union.

2. The CIRAD position paper for decision-makers and opinion leaders.

The launch of the One Health High-Level Expert Panel is a crucial step in preventing global epidemics



© F. Dunouau

**Insights from Thierry Lefrançois,
an expert in integrated approaches and health networks at CIRAD**

What is the aim of the One Health High-Level Expert Panel, initiated by the French government with the support of the German government and launched on 12 November 2020?

Thierry Lefrançois: The Covid-19 crisis has highlighted the critical need to better detect, prevent, manage and control future pandemics, from the local level up to the global level. To achieve this objective, it is crucial to connect the different sectors of human health, animal health and environment, and especially their actors who will be able to dialogue and to listen to one another in order to ultimately anticipate, and to act quickly and effectively. The launch of the One Health High-Level Expert Panel is thus a key step in preventing global epidemics. A group of scientists, of which I am a member, signed an op-ed in the newspaper *Le Monde* calling for the creation of just such a structure. Indeed, the environmental component, which was hitherto somewhat absent from questions concerning integrated approaches to health, will be strengthened with the participation of UNEP in the WHO-OIE-FAO tripartite One Health alliance. This is excellent news.

In your opinion, what role should the High-Level Panel play?

TL: The Panel will make recommendations to foster One Health approaches on an international level. Building on these recommendations, international organizations will be able to help governments to implement measures, procedures and operations in order to ensure better anticipation, surveillance, early action and reaction in the face of disease outbreaks. They must also be in a position to build and promote socio-ecosystems that avoid or limit outbreaks. And if those outbreaks cannot be avoided, then resilient socio-ecosystems are required. The Expert Panel will also need to support and help to steer national, regional and international health policies. Lastly, it must help the most vulnerable countries to set up research and health management systems tailored to their environmental and socioeconomic circumstances.

International partnerships are one of CIRAD's specificities. How is that experience leveraged for health issues?

TL: Several regional networks, which CIRAD created by applying the One Health concept, have already proven effective in helping to limit the entry of animal diseases in specific territories or in controlling them. This is the case of actions conducted by two networks coordinated by CIRAD from two French overseas departments, with CaribVET and One Health OI. These networks have more than 15 years of experience. They have made tremendous efforts to strengthen coordination and to build trust between actors to ensure effective information sharing. Two other platforms in partnership for research and training (dPs) contribute to integrated approaches to health on a regional level: GREASE in Southeast Asia and RP-PCP in southern Africa. They combine research and development activities and long-term partnerships on issues concerning disease emergence or interactions between wild and domestic animals. They have also contributed to improving the management of outbreaks such as that of avian influenza in Vietnam. In France, since 2013, the national platform for epidemiological surveillance in animal health, ESA – for which CIRAD coordinates the international health monitoring unit (VSI), along with ANSES and the French Directorate-General for Food – has been monitoring around 20 health hazards in livestock and wildlife.

How is CIRAD positioned in relation to the creation of the High-Level Expert Panel?

TL: The recommendations it will provide need to be supplemented by research and development actions in all of the geographical areas faced with disease outbreaks. Through its experience in integrated health approaches and the construction of partnership networks, CIRAD has a major role to play in the Panel.

Views taken from an interview published on the CIRAD website on 13 November 2020.

Covid-19 and food security: an overview

From India to Brazil, via Madagascar, Ivory Coast and Colombia, CIRAD scientists and partners have been studying links between COVID-19 and food security. CIRAD published ten articles on the topic online between 15 April and 21 July 2020. Here is a brief summary.

The aim of the published analyses was to gauge the situation in tropical and Mediterranean countries in the wake of the Covid-19 pandemic, which has sparked serious food security concerns. The analysis findings are highly interesting as they offer an insightful snapshot of the situation, while drawing on long-standing field experience.

Multiple challenges

CIRAD researchers noted a worsening of hardship in most of the situations studied. The crisis has highlighted disparities in acutely unequal societies. In Colombia, for instance, the crisis has heightened inequalities between smallholders and large-scale producers, while in Brazil, once again the most vulnerable people are getting hungrier.

The crisis generated high tensions on world rice markets, with only Thailand managing to sustain its exports at the outset of the crisis. Growers of some cash crops, such as cocoa, were extremely wary of the crisis, in light of the already very unfavourable conditions, while milk production was heavily impacted in Madagascar.

The pandemic has also prompted heavier food losses in West Africa due to the dearth of processing tools and supply chains. As however noted by researchers, Covid-19 has had a relatively minor impact on food production in the subregion – “much less than AIDS, dengue fever or malaria”, they claim. In some situations, it has even generated local food production opportunities.

Reactive states, producers and resilient systems

Several states have stepped in with aid for farmers, including a FCFA50 billion support plan for food and fruit sectors in Ivory Coast, emergency income for the most vulnerable people in Brazil, credits for producers in Colombia, etc. Yet the poorest people have had difficulty accessing this aid. At the international level, the G20 moratorium on debt payments

for 77 low-income countries generated 14 billion dollars in liquid assets. This enabled Senegal to buy 140 000 t of local rice to redistribute amongst the poorest.

The overall analysis findings highlighted the resilience of local food systems, which has helped avoid famine. In Madagascar, despite the milk crisis, farming diversification enabled farmers to feed themselves – thereby showcasing the importance of farmer involvement in diverse activities, as opposed to becoming more specialized and industrialized.



Vegetable stalls (tomatoes, celery, green beans, carrots, peppers, etc.) at a market in Cameroon

© L. Parrot, CIRAD

Rethinking inegalitarian models: frontline research

Each analysis reveals avenues for further research. The crisis has highlighted the need for public policies that combine R&D, subsidies and extension. The International Panel of Experts on Sustainable Food Systems (IPES-Food) states that the pandemic has revealed the fragilities and inequalities of a system that is on its last legs. Four recommendations were put forward, including the need to reform international food system governance.

<https://bit.ly/3w5hJsP>

Street food market, Kolkata
© B. Dorin, CIRAD



RunCov: A tale of innovation

RunCov – as reliable as a conventional PCR test but much faster – is a new Covid-19 screening test. It was developed by CIRAD plant health molecular screening experts based at the Crop Protection Unit in Réunion, in partnership with the University of Réunion, the local University Hospital (CHU), ANSES and MNHN.

Interview with Isabelle Robène, a research specialist on the development of plant disease screening methods, who has been involved with RunCov since its inception.

What is RunCov?

Isabelle Robène: RunCov is a SARS-CoV-2 screening test. It is more reliable than antigen tests and able to detect all three major Covid-19 variants simply with a hand-held electrical device. RunCov generates a result within 25 min via the so-called loop mediated isothermal amplification (LAMP) method. CIRAD plant and animal health research specialists have long been interested in this method, especially as it can be implemented in the field at low cost. The ability of RunCov to detect Covid-19 by amplifying not one but two areas of the genome in a single run is innovative, and the choice of primers (small DNA fragments) that target and amplify the SARS-CoV-2 genome is a key feature.

How did you discover RunCov?

IR: When the pandemic broke out, a task force was set up in Réunion with the University of Réunion, the local university hospital (CHU) and CIRAD. Our aim at the time was to assess the possibilities of carrying out PCR tests should the demand exceed the hospital's resources. As a plant health screening specialist, I was field



testing mobile screening methods such as LAMP. This method – besides the fact that it could be performed outside the laboratory – had the advantage of being based on reagents that differed from those used for PCR tests, which are in high demand and therefore potentially at risk of supply shortages. It had to be tested before being proposed for Covid-19 screening.

We therefore set up a team with Emmanuel Jouen, head of the local crop protection research platform, and several technicians from CIRAD and the University, under the aegis of Bernard Reynaud, head of the PVBMT unit, and CIRAD's Regional Director Éric Jeuffrault. We initially decided to use already released RT-LAMP systems, but following their evaluation we opted to design our own primers. Once RunCov was developed it had to be validated. There were two possibilities: applying for a CE label at

considerable cost (around €250 000), or getting it approved by the French National Reference Centre (CNR) for Respiratory Diseases in Lyon (associated with the Institut Pasteur). We opted for this second solution, which is free of charge even though it is more complex as it entails major obligations, which we managed to fulfil. Part of the team went to the CNR in Lyon, and we obtained a positive appraisal, and thus the go-ahead from the French Ministry of Health. All that remained was to find a partner to roll out the test in Réunion. We then signed a partnership agreement with the Cerballiance laboratory.

How has the One Health approach been instrumental?

IR: We collaborated with Catherine Cêtre-Sossah, a virologist specialized in animal health and a member of the ASTRE research unit, who was based in Réunion at the time. The RunCov innovation is the result of our collaboration and discussions based on her expertise in zoonotic diseases and RNA viruses and my plant health research. Access to the CYROI P3 platform enabled us to perform manipulations on the virus. Our two teams collaborated successfully, despite not having previously worked together, and our interactions are ongoing.

Editor's note: At the time of the interview in April 2020, RunCov had already been used twice for screening tests at the Réunion airport, with very promising results. The research team is currently looking for a commercial partner for turnkey development of the test.

Emerging diseases: rethinking health monitoring

The Covid-19 pandemic is prompting a rethink of health monitoring systems, to better identify the epidemic signals triggered by new diseases. Researchers from Europe and North America are looking into this key issue within the framework of the MOOD project, launched in January 2020.

Wuhan's live animal market is believed to have served as an incubator and accelerated the spread of the Covid-19 virus, according to scientists © M.-I. Peyre, CIRAD



The Covid-19 pandemic is a reminder that the systems intended to detect new pathogens of animal origin are in a race against the clock. As an expert in such emerging diseases, most of which come from animals, CIRAD is coordinating the MOOD project (MONitoring Outbreak events for Disease surveillance in data science context), aimed at improving existing tools.

The project has a budget of 14 million euros from the European Union, and brings together 25 partners – research institutions, public health agencies and veterinary services – from twelve countries. The aim is, by the end of 2023, is to offer accessible risk assessment services that take account of ecosystem data relating to climate, migrations, land use and deforestation.

Epidemic intelligence systems rely on two types of information: “official” data reported by public health services, and “unofficial” – but essential – data from internet forums, online press articles and even social media.

To spot the early warning signs among all this information, researchers are developing new watch tools. Faced with Covid-19, the MOOD team quickly rolled out a series of measures, notably the modelling of its transmission, and early detection and monitoring of new variants.

elena.arsevska@cirad.fr

Wild birds are not the only vectors of avian influenza

Well before the SARS-CoV-2 coronavirus, new avian influenza strains have emerged regularly since the early 2000s and subsequently spread far and wide.

Marisa Peyre and Claire Hautefeuille, two epidemiologists at CIRAD, observed that most studies on the topic focused on wild bird movements, while only a minority have given any thought to the role of farmed poultry production and international trade networks.

These highly pathogenic viruses that affect farmed poultry and can be lethal in humans also spread via transport, movements of people involved in various stages of the poultry chain, and mechanical transmission vectors (transport vehicles or contaminated equipment).

The two researchers suggest stepping up collaboration between public research organizations and private players, to boost scientific knowledge on the subject and encourage good veterinary practice.

claire.hautefeuille@cirad.fr



Traditional duck farm in the rice fields of Bali (Indonesia) A. Rival © CIRAD

CIRAD and its partners are hunting zoonoses in Cambodia

The trade in wildlife and consumption of wild meat increase the risks of pathogen transmission from animals to humans. The ZooCov project is looking into this threat, which the Covid-19 epidemic has pushed into the limelight.



Wild animals for sale at a Cambodian market
© Institut Pasteur du Cambodge

The increase in wildmeat consumption, particularly in Southeast Asia, is a growing threat to public health. To help prevent future zoonosis pandemics, CIRAD is coordinating an international project, ZooCov, in Cambodia. The aim is to develop a flexible, integrated system to monitor the risk of betacoronavirus transmission between wildlife and humans.

The project aims to identify the main wildlife trade chains in two pilot areas. Researchers will analyse practices and perceptions concerning wildmeat consumption. They will quantify the presence and diversity of betacoronaviruses,

to identify the vectors of animal infection and human exposure.

This work will serve to develop a methodological framework for the early detection of viral transmission. The system could subsequently be rolled out to other countries and continents, including Africa, which is also a hotspot for the emergence of zoonotic diseases. The French funding body Agence nationale de la recherche (ANR) selected ZooCov following a specific flash call to support French scientific communities working on Covid-19.

veronique.chevalier@cirad.fr

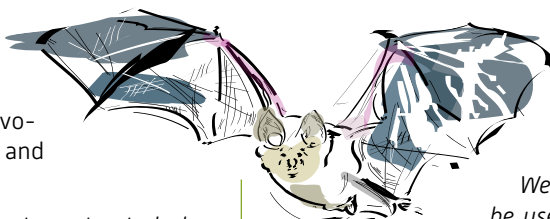
Zimbabwe: researchers are scrutinizing bats that carry coronaviruses

CIRAD, IRD and the University of Zimbabwe, long-standing research partners in animal and zoonotic diseases, have launched a new project on the genetic diversity and prevalence of coronaviruses in two bat colonies.

In 2020, researchers from Zimbabwe and France identified several types of coronaviruses in two colonies of insectivorous and cavernous micro-bats in central and northern Zimbabwe.

"We are working with our Zimbabwean partners to study how coronaviruses and other viruses emerge and circulate in Africa so as to quantify the health risks and prevent future epidemics", says Mathieu Bourgarel, a CIRAD researcher specializing in bats.

The research team collected biological samples from mammals, particularly bats and rodents, and conducted virological and serological analyses. *"If we know the genetic characteristics of*



these viruses better, we will be able to react better, thanks to rapid and customized diagnoses according to already-known strains.

We are in a way preparing a toolbox to be used in the event of transmission of a new coronavirus to humans", IRD virologist

Dr Florian Liégeois explains. Local people are involved in the project, to improve disease surveillance and detection systems and ensure that they are taken on board locally.

mathieu.bourgarel@cirad.fr



Science &



training

Using agroecological intensification to benefit producers in the Sahel

In response to chronic food insecurity in the Sahel, the FAIR project is banking on agroecology to enable smallholders in Burkina Faso, Mali and Senegal to improve their living conditions and make their farms more resilient.

Farming systems in the Sahel are in a critical situation due to their low productivity and to human pressure on the environment. The aim of the FAIR project, in Burkina Faso, Mali and Senegal, is to promote agroecological intensification as a way of providing farmers with a decent income and local populations with healthy food, while conserving natural resources. The project is coordinated by CIRAD, has 9 million euros of funding from the European Union and the Agence française de développement, and will associate ten partners from Europe and West Africa over four years. The researchers involved will use producers' experiences and contributions from R&D players to build new production methods and techniques, in terms of both soils and

their fertility, and the sometimes conflictual interactions between crop and livestock farming.

Forecasting tools will allow the institutional players involved to take a collective look at what is required to structure agroecological value chains. Lastly, on a national and intra-Sahel level, advocacy operations will be conducted to ensure that the project converges with other similar initiatives. The aim is to sustain and extend the agroecological transition of farming systems.

eric.scopel@cirad.fr

Rice paddies near Kolda, Senegal
© S. Taugourdeau, CIRAD



Cocoa agroforestry - the art of reconciling sustainable production and ecological services



A series of studies by CIRAD and IRAD in Cameroon showed that cocoa-based agroforestry systems, associating fruit and forest trees, can provide a credible alternative to cocoa monocultures. The researchers were able to establish that shading cocoa trees with a hundred or so trees per hectare strikes the best trade-off between yield, carbon storage and sustainability. The average yield with this traditional agroforestry practice is 740 kg of cocoa per hectare, if not more. This is three times higher than the figures quoted in previous studies, which were often based on reports from farmers. Cocoa agroforestry systems also serve to capture large quantities of carbon: up to 75 tonnes per hectare, ie half the storage capacity of local secondary forests, and successfully regulate black pod rot and mirids, biting and sucking insects that gradually kill cocoa trees. To pinpoint the best trade-off between cocoa production, ecological services and sustainability in cocoa agroforestry systems, agronomists from CIRAD and IRAD used the concept of basal area, which corresponds to the cross-sectional area of a tree trunk at a height of around a metre. Their work could prompt a re-think of sustainable cocoa certification.

patrick.jagoret@cirad.fr



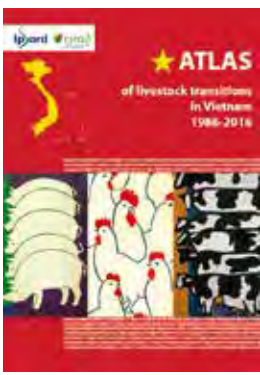
In the Senegal groundnut basin © R. Belmin, CIRAD

Getting to work on the agroecological transition in Senegal

Senegal is keen to be seen as a spearhead in terms of agroecology. In February 2020, a policy position paper resulting from a novel type of consultation was handed to the Senegalese government.

The agroecological transition, which is supported by Senegalese President Macky Sall, is intended to respond to increasingly severe climate hazards, strong population growth and the adverse environmental consequences of the Green Revolution. CIRAD has participated in work in the country by the Dynamique sur la transition agroécologique au Sénégal (DyTAES). This group, which associates the main agroecology players in Senegal, conducted a novel survey of more than a thousand agricultural stakeholders, visited around thirty sites and made a diagnosis of the major issues in terms of agriculture, livestock production, rural development and food security. Its final report recommends building a framework for national multi-stakeholder dialogue, providing financial support for experiments on a local scale, and immediate measures capable of leveraging the agroecological transition, such as subsidizing biofertilizers and biopesticides, cutting the price of productive water, and supporting assisted natural regeneration.

sylvie.lewicki@cirad.fr



An atlas aimed at slowing the galloping industrialization of livestock farming in Vietnam

To counter the development of mega-farms in Vietnam, CIRAD and its partner IPSARD offer a comprehensive decision support tool: the *Atlas of livestock transition in Vietnam*.

Vietnam is faced with the galloping intensification and industrialization of its livestock sector. Private firms are racing to outstrip each other, and developing at record speed. Between 2000 and 2015, poultry numbers doubled in Vietnam, the number of fattening pigs increased from 21 to 28 million, and the dairy herd increased sevenfold. With more than 100 maps and graphs, the *Atlas of livestock transition in Vietnam* highlights the limitations of the current model. It calls on the authorities to arbitrate between the economic,

environmental and social impacts of this industrialization.

The atlas is published by CIRAD and IPSARD, and suggests that public policy be built on win-win partnerships between private companies, family farms and local authorities. That policy could simultaneously encourage sustainable ecosystem management and address the challenges of profitable production, food security and rural employment.

guillaume.duteurtre@cirad.fr



Dairy herd on the VN FutureMilk farm north of Hanoi © J-D. Cesaro, CIRAD

“ASSET”: a new tool for fostering sustainable agroecology in Southeast Asia

CIRAD is the scientific coordinator of the ASSET project, prompted by the fact that agricultural and food systems are now at the crossroads between conventional intensification models and innovative agroecological initiatives.

Southeast Asia has reached a crossroads. CIRAD and its partners have launched the ASSET project (Agroecology and Safe food System Transitions) to foster transition within food and farming systems by exploiting the potential of agroecology. This far-reaching five-year programme, which is funded to the tune of 12 million euros by the Agence française de développement (AFD) and the European Commission, and orchestrated by GRET, will involve 27 partners in Cambodia, Laos, Myanmar and Vietnam. Agricultural systems are increasingly organized around intensive, specialized monocultures, adopting the principles of the Green Revolution: high doses of fertilizers, improved varieties and GMOs for some crops, insecticides, artificial insemination, etc. At the heart of this action research project, the partners of three platforms in partnership of which CIRAD is a member (MALICA, ASEA and GREASE) will work hand-in-hand with players in the four countries, to draft a road map for agroecology.

melanie.blanchard@cirad.fr



Conservation agriculture in Cambodia: sowing maize over an Indian hemp cover © V. Sar

A European Alliance for chemical pesticide-free agriculture

There's strength in numbers. In February 2020, 24 European research organizations committed to work together to find alternatives to the use of synthetic pesticides.

CIRAD has joined up with its peers in Europe to sign a declaration, "Towards a Chemical Pesticide-Free Agriculture". The declaration, initiated by the French National Research Institute for Agriculture, Food and Environment (INRAE), the Leibniz Centre for Agricultural Landscape Research and the Julius Kühn Institute, has 24 signatories.

The declaration, which is backed by the French Ministries of Agriculture and of Research, was formalized at the Paris International Agricultural Show on 23 February, in the presence of Amélie de Montchalin, Secretary of State for European Affairs. This unprecedented undertaking will mobilize an entire research community to build alternatives to chemical pesticides and support public policy making. CIRAD will be contributing as regards the issue in the ultraperipheral regions, particularly the French overseas regions. The declaration sets out numerous common research avenues and calls for systemic, multidisciplinary approaches. The methods used must reinforce the links between the production of knowledge and the experimentation process, both in the lab and in the field. Links with the world of agriculture should enable the rapid rollout of changes and large-scale testing of alternative solutions.

presse@cirad.fr

The links between deforestation and zoonoses are often still largely unexplored

The global Covid-19 pandemic has shed light on the importance of the relationships between ecosystems, their biodiversity and the emergence of new infectious diseases. However, scientific knowledge of those links is still too sketchy, according to researchers from INRAE, CIRAD, IRD and the Institut Pasteur in French Guiana. They analysed 565 papers published between 1953 and 2018 on the relationships between forests, deforestation and zoonoses.

In a systematic review published in the journal *Environmental Research Letters*, they noted a taxonomic bias in the articles, since a large number of papers had to do with Lyme disease or cutaneous leishmaniasis and concerned the Americas. Fewer than one in eight dealt with the relationships between forests, deforestation and zoonoses, and they only covered a tiny portion of the infectious cycle – vector insects or reservoir animals –, without looking at their interactions with viruses, bacteria or protozoa. Moreover, the vast majority of the articles did not discuss any connections with human cases. The study will serve to redirect research on the topic, to take account of environmental, anthropological-sociological, economic and political components.

julien.cappelle@cirad.fr



Researchers from INRAE, CIRAD, IRD and the Institut Pasteur in French Guiana analysed 565 scientific articles © B. Locatelli, CIRA

French scientific research is working for a sustainable world

All French scientific publications on biodiversity have now been grouped under the hashtag #ScienceDurable (sustainable science). The "Science for a sustainable world" campaign is led by the AllEnvi alliance and the Fondation pour la Recherche sur la Biodiversité (FRB), of which CIRAD is a member. It allows researchers working on solutions and levers for action to counter the risks of animal and plant species becoming extinct to share their work with the general public via social media. Among other things, this makes it possible to find out about the "mystery of eternal rice" or "the role of environmental DNA in supporting deep-sea biodiversity".

pauline.coulomb@fondationbiodiversite.fr



F. Le Bellec © CIRAD

**Amazon rainforest:
Camille Piponiot-Laroche
has been awarded a
Dufrenoy silver medal for her
work on the long-term impact
of selective commercial
logging**



In July 2020, Camille Piponiot-Laroche was awarded a Dufrenoy silver medal for her thesis on the future of production forests in the Amazon.

Her work, which was co-funded by CIRAD and CNRS, decoded the long-term impact of selective commercial logging, which affects between one and two million hectares in the Amazon each year.

The French Académie d'Agriculture recognized her "thorough assessment" of the carbon balance and of the compromises between ecosystem services (lumber, biodiversity and carbon). That assessment will serve to re-think forest production strategies and the balance between new plantings and low-impact logging of natural forests. In October, Camille Piponiot-Laroche, a forest ecology researcher, joined CIRAD's Forests and Societies research unit as a modeller specializing in scale changes, where she will be continuing her work on forest ecosystem functioning.

camille.piponiot-laroche@cirad.fr

European coffee tasters have assessed forgotten species

CIRAD organized a tasting session with coffee experts in December 2020. The aim was to determine which wild species, which are more resilient, consumers might like.

Of the 124 known coffee species worldwide, just two regularly turn up in our coffee cups: Arabica and Robusta. To broaden the range and make the coffee value chain more resilient, specialists from CIRAD organized a blind tasting session of three coffee species held by the *Coffea* Biological Resource Centre (BRC). The jury brought together eight experts at CIRAD's sensorial analysis laboratory in Montpellier and four others remotely (in Switzerland, the Netherlands and Belgium). *"Adopting new species for general consumption is not a trivial undertaking. First of all, science has to demonstrate their merits in*

terms of productivity and quality. The next step is ensuring that industry and consumers take them on board", says Benoît Bertrand, a breeder at CIRAD and Coffee Value Chain Correspondent.

This tasting session was intended to lift the first barrier – demonstrating that the species correspond to consumer tastes –, before demonstrating the agronomic merits of these new species the coffee industry does not yet know about, which could resist both higher temperatures and coffee leaf rust.

benoit.bertrand@cirad.fr

A novel coffee tasting session was held at CIRAD's sensorial analysis laboratory on 10 December 2020
© C. Cornu, CIRAD

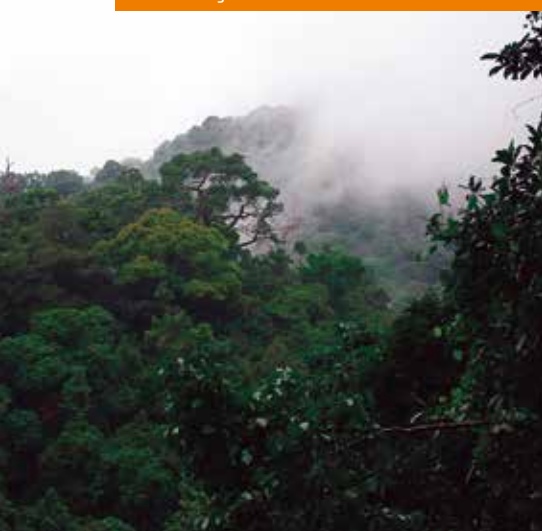


The dense rainforests of Africa have been inventoried

CIRAD has built a database produced from almost 100 000 hectares of dense forest inventories in Central Africa, and a second, with IRD, that gives forest carbon stocks. The data have been published in the journal *Nature-Scientific Data*, and will be used as a reference for a set of analyses.

The dense rainforests of Central Africa, the world's second largest expanse of tropical forest after the Amazon, are some of the least known on the planet in scientific terms, while almost 30 million hectares of production forests have been inventoried by loggers, according to their own protocols. For almost 20 years, CIRAD has been working with consultancies and dozens of forestry companies in Central Africa to build a novel database: named CoFor (Congo Basin Forests), it contains data from 100 000 hectares of inventories in five countries. In turn, by means of an analysis method developed by CIRAD and IRD, those data have enabled the creation of a second database, CoFor-AGB (Above-Ground Biomass), to estimate forest carbon stocks. The carbon stock estimated in the context of this analysis ranges, for 95% of observations, between 115 and 485 tonnes per hectare, with highest values observed

Forest in southwestern Cameroon, in the mist
C. Doumenge © CIRAD



in a region stretching from central Gabon to some parts of the Central African Republic in the extreme North of the forest area, via southeastern Cameroon and northern Congo. CoFor-AGB is an exceptional source of data that can serve as a reference for large-scale analyses of tropical rainforests and biomass stocks on a global level, calibrate models aimed at mapping biomass across the whole Central African dense forest area, or to improve estimates of CO₂ emissions associated with forest disturbances in the context of projects under the international initiative REDD (Reducing Emissions from Deforestation and Forest Degradation).

sylvie.gourlet-fleury@cirad.fr

frederic.mortier@cirad.fr

<https://go.nature.com/3wx4txG>

The “4per1000: soils for food security and climate” initiative has reached the French overseas regions

The French Ministry for Overseas Territories, CIRAD, INRAE and IRD have signed a framework agreement for the rollout of the “4per1000” international initiative in the French overseas regions. The initiative promotes agricultural and forestry systems that stock more carbon and organic matter in the soil, to make them more resilient to climate hazards and less chemical fertilizer-intensive while boosting their productivity. This serves to foster food security, the agroecological transition and adaptation to climate change.



The signing of the framework agreement between the French Ministry for Overseas Territories, CIRAD, INRAE and IRD at the Paris International Agricultural Show on 24 February 2020. Left to right: “4per1000” Executive Secretary Paul Luu; CIRAD President Managing Director Michel Eddi; Minister for Overseas Territories Annick Girardin; INRAE President Philippe Mauguin and Jean-Luc Chotte, a researcher representing IRD © S. Della Mussia, CIRAD

PUBLICATION

What does the future hold in terms of food security and land use?

In response to global issues, new scenarios have been built to help decision-makers and scientists re-think our food systems. The Agrimonde-Terra foresight study, coordinated by INRAE and CIRAD, concerns land use and

food security, with a particular focus on nutrition and health aspects. The results, published in the journal *PLOS ONE*, highlight the importance of considering very contrasting diets, and the key role played by rural-urban relations in transforming food value chains. While the study confirmed that a move towards healthier diets could help reduce the spread of agricultural land, it revealed two new scenarios that resonate with the impact on food security of the Covid-

19 pandemic: the possible reconnection of the agrifood industry and regional production, to counter the fragility of supply chains, and the prospect of a “perfect storm” induced by an accumulation of crises.

marie.de_lattre-gasquet@cirad.fr

patrice.dumas@cirad.fr

<https://doi.org/10.1371/journal.pone.0235597>

West Africa

A new varietal breeding programme will benefit 40 000 producers

Plant breeding is a key challenge for agricultural producers in the light of climate change and population growth. A new project is strengthening networks and institutional capacity in Burkina Faso, Niger and Senegal.

Within a consortium of national, regional and international varietal breeding institutes, CIRAD is working on the ABEE (West Africa Breeding Networks and Extension Empowerment) project, to improve food crop varieties (cowpea, groundnut, millet, sorghum and fonio) that are essential to food security and highly sensitive to climate change. Varietal breeding will be coordinated using a knowledge base for breeding programmes and genetic material exchange networks will be strengthened. International partners will help breeders modernize their practices, with equipment and methods that are little used in Africa (digitization, molecular genetics and IT development plans, etc.). Capacity building among researchers in national systems and training for future generations of breeders and scientists will deliver lasting results after the end of the project.

daniel.fonceka@cirad.fr • jean-francois.rami@cirad.fr

Groundnut producers from the Fatick region (Senegal) visiting demonstration plots of new varieties © Hodo-Abalo Tossim



Supplying bioenergy to small and medium-sized enterprises (SMEs)

Improving energy supply to food processing SMEs thanks to bioenergy in West Africa is the goal of the BIOSTAR project, coordinated by CIRAD in collaboration with nine African and European partners.

BIOSTAR is funded by the European Union and Agence française de développement, and is part of the European DeSIRA (Development Smart Innovation through Research in Agriculture) programme aimed at boosting innovation in agriculture and the transformation of food systems to make them more resilient to the effects of climate change. The project centres on the energy requirements of agrifood SMEs in city suburbs, and on how they manage their organic waste. It offers SMEs on-site bioenergy production units to recycle that waste. As of 2020, in Senegal and Burkina Faso, SMEs representative of five agrifood sectors (cashew nut, groundnut, shea, mango and rice) were due to be selected, and 16 prototypes of bioenergy production equipment to be adapted to the situation of each SME. Thanks to the project, SMEs will be able to relocate to rural areas, closer to raw materials (hence less transport, reduced post-harvest losses and better processed product preservation), which will make rural areas more dynamic, safeguard players in the agrifood sector and reduce the sector's impact on climate change.

joel.blin@cirad.fr



Cashew nut shelling produces large quantities of highly acidic, corrosive shells, which can be used as a fuel to produce energy
© J. Blin, CIRAD

Overlapping perspectives on gender and food

CIRAD and the UNESCO Chair in World Food Systems organized the third, virtual edition of the “Eating in the Cities” symposium, on 30 September and 1 October, with 480 participants from more than 40 countries. The event shone a light on gender relations and change across continents.

Urbanization is happening rapidly in Africa, Latin America and Asia, and most people remain vulnerable. Very different food systems co-exist (in terms of points of sale and product types), and the speed of the changes under way is impacting on gender relations. However, meals are still very largely prepared by women (with the added responsibility of producing healthy, “homemade” food), who also carry out other domestic tasks, which is hampering their emancipation. Paradoxically, the Covid-19 pandemic has redistributed food-related tasks in some cases, while in others, it has confirmed their distribution between men and women.

Nevertheless, gender is indeed a socio-cultural construct, particularly in urban areas, where on the one hand women are moving into activities previously dominated by men (they are known as “male women” in Abidjan), and on the other, anonymity is allowing men to transgress social norms. In all the world’s urban areas, the commercial space dominates in terms of access to food, impinging on the domestic space and division of tasks. The digital space (social



Covered market in the city of Siem Reap, Cambodia © C. Dangleant, CIRAD

media) has blurred the distinction between the domestic and public spaces, and boosted diversity. A third space, relating to objections to meat consumption, tackles the issue of the patriarchy

and the belief that women are more ecologically committed than men.

justine.labarre@cirad.fr

<https://www.mangerenville.org/en>

GloFoodS reveals its first results

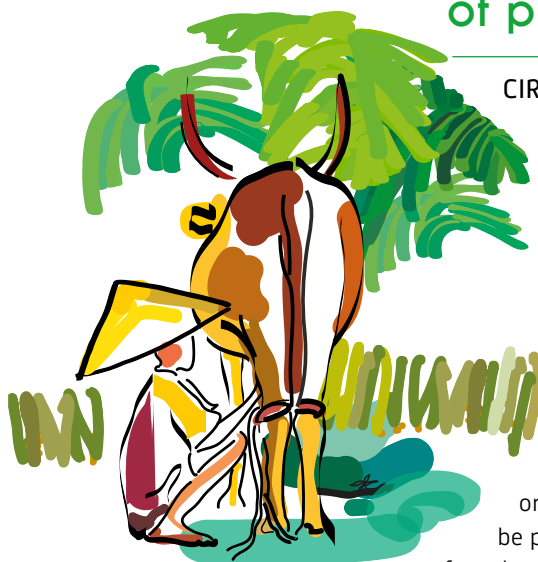
The GloFoodS metaprogramme on transitions for global food security is part of the global research drive on food and nutrition security, and has mobilized CIRAD and INRAE since 2014. After two calls for expressions of interest, the results of a first wave of projects are now available, in the form of a series of notes. GloFoodS juggles food transition issues and the challenges of adapting to global change. It links the availability of foodstuffs with the other “pillars” of food security (access, use and stability), and is working to establish the underlying mechanisms. Drawing on the complementarity of the two scientific communities involved, GloFoodS has compared global and local approaches and built novel multidisciplinary approaches (agronomy, environment, economics, zootechnics, food engineering, sociology, nutrition, etc.).

etienne.hainzelin@cirad.fr



Drying rice in a coastal village in southern Cambodia © C. Dangleant, CIRAD

Making better use of local milk in the face of pressure from imports in the Sahel



CIRAD has presented a report on the environmental and socioeconomic impacts of European exports of milk powder to West Africa. The study was commissioned by a group of MEPs, and consisted of a comparative analysis of local milk and imported milk powders, followed by recommendations for local value chains.

Imported powders make up the bulk of raw materials used by dairy industries in the Sahel, and local demand is growing rapidly. Depending on the country, only 1 to 7% of milk produced locally is collected, while the rest is consumed by the producers themselves or sold on rural markets. This can primarily be put down to the difficulty of collecting milk from local agropastoral areas, and the lowering of tariff barriers in West Africa over the past decade. In

2019, fat-filled milk powders represented more than two thirds of West African milk imports. Fat-filled powders are cheaper than powdered milk, most contain palm oil, and up to a third are not clearly labelled.

The study recognizes the importance of imports for West Africa, but encourages European companies to adopt a responsible strategy, to ensure that sales of these fat-filled powders do not hinder the development of African dairy chains. Moreover, West African livestock farming systems promote natural ecosystems that are very rich in biodiversity, generate less greenhouse gas and consume less fossil energy than European dairy farming systems. Tax measures and incentives for local milk collection could boost the value chain, by making imported milk powder less attractive for manufacturers and encouraging partnerships between local dairies and producers.

guillaume.duteurtre@cirad.fr • christian.corniaux@cirad.fr



Farmer milking one of his animals
E. Daou © CIRAD

Pastoral communities are highly varied

A study commissioned from CIRAD by FAO set out to study pastoralism in Argentina, Chad and Mongolia. Although some 200 million farmers make their living from pastoralism worldwide, it remains a little-known agricultural activity, despite its far from negligible contribution to GDP. In all three countries studied, there is a high level of inequality in pastoral communities: major disparities in terms of land use raise the issue of access to productive resources. Livestock farmers live in an uncertain environment and rely on their families and social capital to adapt. To visualize the different contributions and the requirements of pastoral activities, the study recommends setting up observatories of pastoralism, based on a network of partners, including pastoral organizations, which play a determining role in policy dialogue.

abdrahmane.wane@cirad.fr • veronique.ancey@cirad.fr



Pastoral farmer and his animals in the Ferlo region, northern Senegal

PADI-web: online animal health

CIRAD is developing PADI-web, a platform to monitor animal health using information from online news articles. The team reported on its promising results in a paper published in *Computers and Electronics in Agriculture*.

PADI-web [Platform for Automated extraction of animal Disease Information from the web] is an online health monitoring platform. It processes hundreds of Google News articles per day to monitor diseases related to animal health, both well-known and new (coronaviruses), and searches articles for information (diseases, symptoms, dates, places, etc.) and keywords (epidemic, virus, alert, etc.). It supplements official sources with information gathered all over the world and translated into English before being checked by experts, which sometimes serves to detect disease clusters.

For the International Health Monitoring Unit (VSI) of the French Animal Health Epidemiological Surveillance Platform (ESA), PADI-web saves a lot of time, since it automatically detects health issues mentioned in online news articles. The platform differs from existing tools because of its narrower focus on animal health, and is due to be used by the European MOOD project, coordinated by CIRAD, which is working to associate a range of tools in order to build a highly efficient health monitoring system..

padi-web@cirad.fr

<https://doi.org/10.1016/j.compag.2019.105163>

Traditional duck farm in the rice fields of Bali (Indonesia) A. Ri al © CIRAD



Training workshop in HLB disease in Guadeloupe

A dozen farmers from Guadeloupe took an advanced training course in HLB disease at the Roujol station, organized by CIRAD and ASSOFWI with the support of VIVEA, within the framework of several European projects.

Training course on HLB disease led by Raphaël Morillon at the Roujol research station, Petit-Bourg, Guadeloupe © H. Rabillé, CIRAD



The course lasted a day, and covered three topics: (i) information on HLB or Huanglongbing disease (origin, infection and spread mechanisms, symptoms, impact on tree physiology and fruit development, virulence and host range, and vector insects and their identification); (ii) the importance of choosing the right rootstock when planting citrus trees, depending on local environmental and soil conditions; and (iii) the research under way at CIRAD in Guadeloupe to understand the physiological and molecular bases of the disease tolerance observed in certain varieties (linked to polyploidy), and to create new fruit tree varieties and tolerant rootstocks. The participants visited a trial plot planted with a "Tahiti lime" type triploid hybrid in the aim of breeding ideotypes more tolerant of HLB and tailored to local consumers' tastes. They also toured a trial plot of various diploid and tetraploid rootstocks, to look into the issue of the identification and true-to-type reproduction of the best rootstocks. Lastly, they tasted a range of local and imported citrus fruits, to define their organoleptic qualities and pinpoint demand from the local market.

raphael.morillon@cirad.fr



Climate change means an increased risk of antimicrobial resistance in aquaculture

A study has raised the alarm regarding the development of antimicrobial-resistant bacteria in aquaculture, which is affecting fish production and human health worldwide. It established for the first time a link between global warming and an increased risk of antimicrobial resistance.

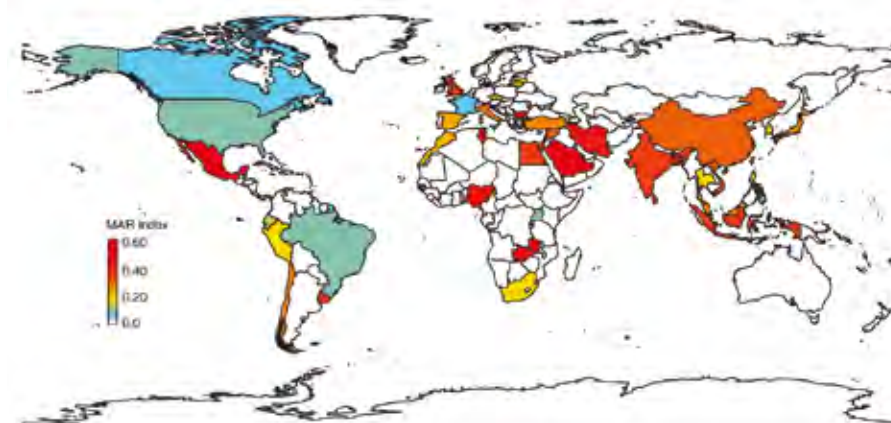
Aquaculture plays a vital role in food security, particularly in Asia. Fish farmers use large quantities of antimicrobials to treat or prevent disease, but when used inappropriately, antimicrobials foster the development of resistant bacteria. Researchers from IRD and CIRAD conducted a meta-analysis of data on the effect of temperature on the mortality rate of aquatic animals infected with pathogenic bacteria commonly found in aquaculture. They then conducted a systematic review of the resistant bacteria found on fish farms and calculated the Multi-Antibiotic Resistance (MAR) index for 40 countries. This showed high antimicrobial resistance indexes for many countries (index > 0.2), for instance Indonesia and China.

Global warming fosters pathogenic bacteria that cause disease on fish farms, hence a potential increase in antibiotic use, with consequences for human health and the sustainability of aquaculture: resistant bacteria or their genes could be transmitted to humans and increase the number of deaths linked to antimicrobial resistance, which already causes some 700 000 deaths worldwide each year. Urgent action is required to help producers find alternatives and encourage multidisciplinary One Health and Eco-Health research.

rudu.gozlan@ird.fr

samira.sarter@cirad.fr

<https://doi.org/10.1038/s41467-020-15735-6>



Map showing multi-antibiotic resistance worldwide. The index is calculated by determining the ratio between the number of antibiotics to which an isolate is resistant and the total of antibiotics to which it was exposed (an index >0.2 indicates high antibiotic contamination).

© Miriam Reverter et al., *Nature Communications*



Feeding fish in floating cages in Indonesia (Léa Cirata). Indonesia has a high antibiotic resistance index (0.355), which poses a health threat to its fish farm.

© M. Legendre, IRD

Land inequality: a new model is possible

A report, “Uneven Ground: land inequality at the heart of unequal societies”, by the International Land Coalition (ILC), in collaboration with CIRAD and OXFAM, sheds new light on the growth in land grabbing.

Land inequality is rising, and is significantly higher than previously recorded. In addition to land areas, the ILC report considers the value of land, multiple ownership and landlessness, as well as control over those factors, and reveals the extent of land inequality worldwide: the top 10 percent of the rural population captures 60 percent of agricultural land value, while the bottom 50 percent of the rural population controls just 3 percent. This is exacerbated by increased interest in agricultural land from investors: 1% of farms operate more than 70 percent of the world's farmland, while over 80 percent are smallholdings of less than two hectares. If the trend continues, land inequality will have significant negative consequences for all societies, on economic and social development, on the environment and on democracy. However, a fairer agricultural production model is possible, with democratization of land governance, stricter land-related regulation, full transparency of land holdings and true recognition of minority rights.

ward.anseeuw@cirad.fr

After three years of research, the International Land Coalition has published a report on land inequality worldwide. The new data reveal a 41% increase in inequality compared to previous records
© E. Malézieux, CIRAD



The G20 is calling for greater transparency in terms of large-scale land acquisitions

A policy brief drafted by a group of experts for the G20 flags up the continuing lack of transparency in large-scale land acquisitions. Global population growth and increased meat consumption have triggered such acquisitions, which often involve G20 member states and are frequently to the detriment of local people, ecosystems and biodiversity. The G20 has recognized the need for more responsible land investments, but the working group stresses several points to encourage concrete action: drafting common minimum standards to ensure due diligence as regards human rights when auditing acquisitions; encouraging responsible, transparent agricultural investment by G20 member states; and making information on large-scale acquisitions publicly available, particularly on the part of public entities.

ward.anseeuw@cirad.fr • jeremy.bourgoin@cirad.fr



Agricultural land acquisition (sugarcane) in the Senegal River delta
© J. Bourgoin, L.Touré (CIRAD)

Dinamis: simpler access to spatial images

The DINAMIS portal, a national institutional satellite image sharing platform, has made it easier to access very high spatial resolution images for research, land use planning or environmental management purposes. It is linked to the Data Terra research infrastructure, and organizes resource sharing, data supply and user support, and contributes to the development of new products and services for policymakers.



SPOT image (July 2019) of the Piton de la Fournaise, a volcano on Réunion Island, available on the DINAMIS portal © ADS GeolIntelligence

jean-francois.faure@data-terra.org

A new observatory of agriculture in the Indian Ocean

The PRêRAD-OI regional platform is leading an observatory of agriculture within the southwestern Indian Ocean. The facility will foster the agroecological transition and address the food, health and environmental issues facing that part of the world.

The Indian Ocean regional agricultural research for development platform (PRêRAD-OI) is intended to structure regional agricultural research, and federates more than 50 partners. It was founded in 2014 under the aegis of the Indian Ocean Commission (IOC) – associating Madagascar, The Comoros, The Seychelles, Mauritius and Réunion – with the support of the Réunion Regional Council and the French government, and is led by CIRAD. In 2021, PRêRAD-OI will be launching a regional version of the World Agriculture Watch (WAW) led by FAO and CIRAD: the Observatory of Agriculture in the Indian Ocean (OA-OI), to compare farms and enable varying levels of investment to foster the agroecological transition. The tool will benefit producers, value chains and the authorities, and other entities in the region (Mayotte, Mozambique, etc.) have already shown an interest. The platform is also planning to build two new scientific networks, on biomass use for energy purposes and organic waste recycling in the soil, to steer farms towards a circular economy.

isabelle.mialet-serra@cirad.fr

Drying rice and transporting sheaves;
soil preparation in rice fields near Betafo, Madagascar
E. Gozé © CIRAD



Fighting deforestation can support development in the Amazon

TerrAmaz will be helping five pilot sites in the Amazon (in Brazil, Colombia, Ecuador and Peru) to reconcile sustainable territory management and the fight against deforestation. The project, led by CIRAD, ONF-International, AVSF and AFD, is part of a commitment to achieve the sustainable development goals.

To reconcile the transition to sustainable agriculture, forest resource and biodiversity conservation, and social inclusion, TerrAmaz will be developing territorial engineering tools: indicators to monitor territories in transition, in terms of the spatial dynamics of land use, regulations or incentives, and the degree of commitment on the part of local public and private players; and technico-economic benchmarks for sustainable crop farming, livestock farming and forestry systems. The project will support several farm networks through their agroecological transition, and hundreds of family farms that will benefit from agro-environmental contracts. The project will roll out a decentralized sustainable territorial management approach across the Amazon Basin, to reconcile biodiversity and natural forest conservation with agricultural development for the benefit of local communities. It will be an opportunity to build on tools developed with partners in Brazil and serve to stabilize the agricultural frontier in Colombia and extend multi-stakeholder governance in Ecuador.

rene.poccard-chapuis@cirad.fr

Paragominas, in Brazil, is one of the TerrAmaz project's five pilot sites
© R. Poccard-Chapuis, CIRAD





A new support unit, new aspirations

An exciting year for training

In addition to consolidating collaborations with L'institut Agro, 2020 was an opportunity for education and training at CIRAD, a time to structure, adapt and progress... A look back at an eventful year with Magali Dufour, Education and Training Officer at the DGDRS.

What is the role and scope of training at CIRAD?

Magali Dufour: Training at CIRAD is a natural progression of our long-standing involvement and the adoption of new strategic priorities in 2019 (SPSO2, Contractual Objectives with the State), which confirmed our major training commitment to our partners in the global South. In 2020, the first initiatives towards fulfilling this commitment were formulated. They are being carried out in collaboration with a close partner of CIRAD – L'institut Agro, and especially Montpellier SupAgro, its Montpellier-based component. This partnership is crucial as teaching and training are not the main focus of CIRAD, which is primarily a research institute.

We provide training engineering support for CIRAD researchers and teacher-researchers from L'institut Agro. We do not supersede the teams, instead we help them prepare their projects, define their objectives and specify methods for organizing their training courses. They also benefit from our knowledge and experience with partners in the global South, field conditions and donors. Depending on the type of need, we set up and make effective use of new intervention methods with a view to disseminating them: comprehensive courses, modules, training of staff from partner institutions such as CNRA, etc.

Could you indicate the main training milestones achieved in 2020?

M.D.: 2020 was devoted to defining the terms of our collaboration with L'institut Agro. We created a shared support unit, the *Pôle pour l'enseignement et l'ingénierie de formation au sud* (a platform for training education and engineering in the global South), or 'Pollenis'. We opted for flexible management, with a coordination unit of six people (three from L'institut Agro, three from CIRAD), with everyone retaining a foothold in their home institution. The missions are to develop common strategic orientations, support the development and implementation of joint expertise and projects, and disseminate the deliverables. This first involved drawing up operational guidelines specifying the request submission and processing procedures. Given the long history of collaboration between our two organizations, we have continued our ongoing projects, but 2020 was also an opportunity to lay the foundations for future projects. For example, the team developed proposals for the 'Partnerships with African Higher Education' tender call launched by the French Development Agency (AFD). The results should be announced in 2021. Among the highlights, I should also mention the recruitment of a training engineer who will provide support for all of these training engineering and networking aspects, in line with our institution's training thrusts.

What impact has the 2020 health crisis had on training and teaching at CIRAD and what are your hopes for the future?

M.D.: The health situation has forced us to rethink the way we work. Our e-learning platform has been more relevant than ever. We have also set up two webinars offering CIRAD researchers the possibility of transforming planned face-to-face training into distance learning, while providing tailored support for training reorganization.

Our hope is that what has been set up will be successful in the long run, with our expertise having a marked influence with regard to designing and implementing training courses in tropical and Mediterranean countries. In addition to this ambition, there has been a major shift in our training scope. Previously, CIRAD was mainly focused on providing training courses at the Masters level and above, whereas now we intend to be involved in training courses from the secondary school graduate level and upwards (Baccalaureate +2 and +3 years), with a view to making them more professional. We will strive to mainstream graduates into the economic sphere, especially in many African countries where major demographic issues prevail, with an excess of students entering the universities. We also earnestly hope to contribute to setting up training courses on topics of interest to our partners, e.g. agro-ecological transition, climate change adaptation, etc., while also showcasing our research outcomes.

<https://www.cirad.fr/en/our-activities-our-impact/teaching-and-training>

<https://elearning.cirad.fr/>



© Unsplash



Plantain at the cutting edge of agricultural training

The FABA project is coordinated by CIRAD with the support of L'Institut Agro in association with the FAR International Network. This two-year project aims to provide training in West and Central Africa on ways to produce more plantain using better practices.

FABA primarily targets plantain growers, as well as farming advisors and teachers, with the support of Ivorian, Cameroonian and French partners representing the bulk of stakeholders in the plantain sector. The many aims of this project include boosting the awareness of plantain growers in terms of agroecological cropping practices, safeguarding health and the environment while addressing food security issues. FABA is an integral part of the process of forging closer ties between L'Institut Agro and CIRAD with regard to training outreach in the global South (see interview with Magali Dufour opposite), and the project involves three phases: i) an analysis of training needs of farmers and stakeholders throughout the plantain sector;

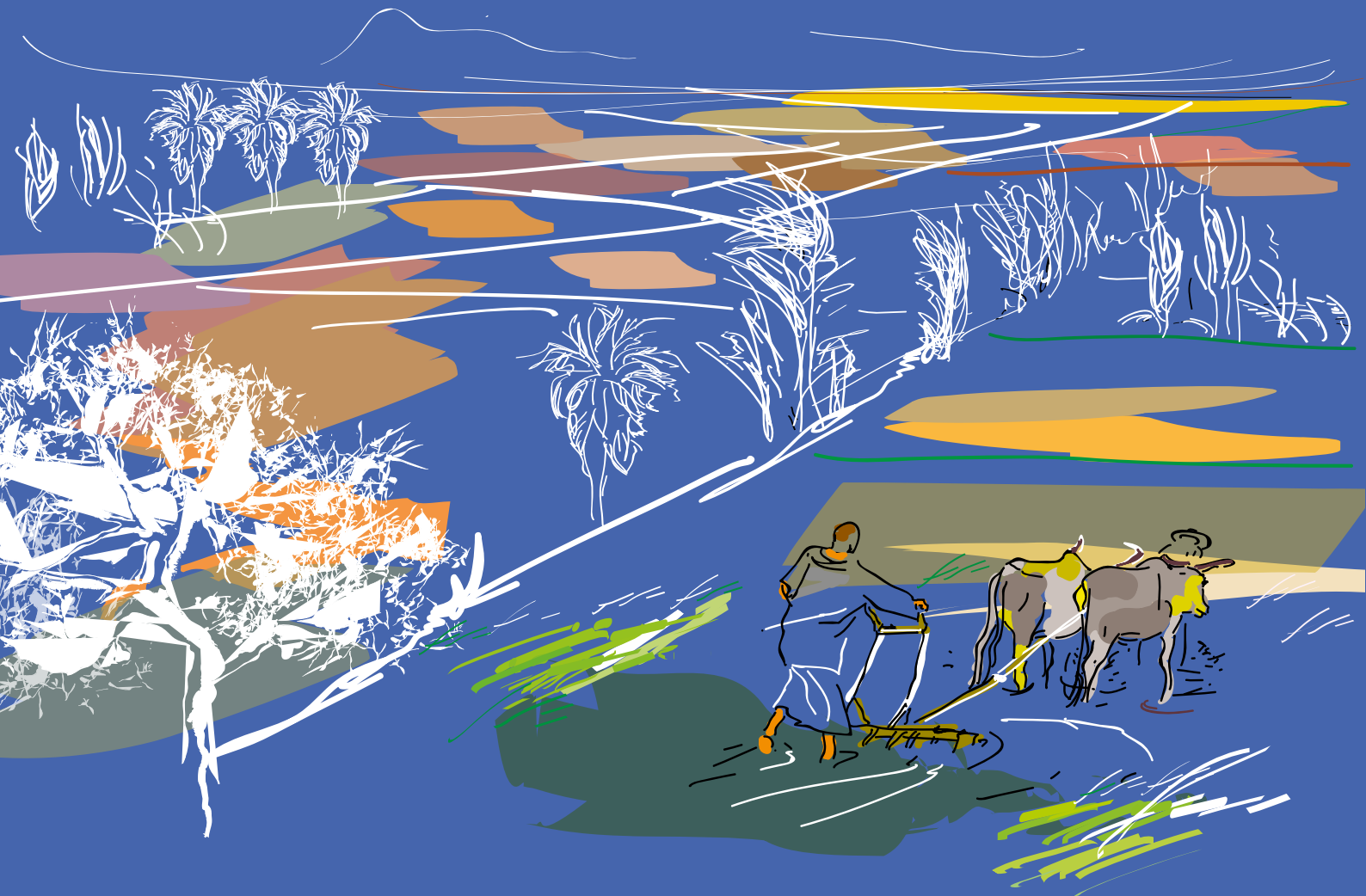
ii) developing various educational resources, including a library of educational videos for easy viewing online and via smartphones, while also being mainstreamed into different educational programmes; and iii) broad dissemination of educational resources developed in partnership with local agricultural extension and training operators. FABA is viewed as a pilot project that could be further developed in other fields and/or to deal with different issues. The project is financially supported by the French Ministry for Europe and Foreign Affairs (via FSPI, the Solidarity Fund for Innovative Projects) and the French Ministry of Agriculture and Food.

sylvain.depigny@cirad.fr

Plantain banana producer focus group in Cameroon: survey of training requirements
© O. Sadoung



Partnerships



| CENTRAL AMERICA |

CIRAD and CATIE extend their 30-year partnership

For more than 30 years, CIRAD and CATIE have been contributing through their joint projects to improving the quality of life of rural populations in Central America.

“The scientific research that we have developed with CIRAD has helped to improve the quality of life of rural populations”, says Muhammad Ibrahim, Director General of CATIE, a research

centre dedicated to tropical agriculture in Costa Rica. “We hope to continue to strengthen this collaboration in order to contribute to delivering solutions to meet the needs of the region.” A dozen joint projects are currently under way, on agroforestry, coffee and cocoa. They include PROCAGICA, launched in 2016, which aims to build resilience to climate change and to coffee rust. Since 2017, the Forecast project has built a platform of educational resources and modelling tools for agroecology in forest landscapes. According to CIRAD President Managing Director Michel Eddi, collaborating at the local level is the best way to address climate change and biodiversity loss. *“Our two institutions have the capacity to build a common future, working together to mobilize resources and skills on objectives and projects in partnership”, he says.*

guy.henry@cirad.fr



Fruits d'un caféier Arabica sélectionné à la station de recherche de Heredia au Costa Rica. C. Cilas © CIRAD



Left to right: Grégoire Leclerc (CIRAD), Muhammad Ibrahim (CATIE DG), Michel Eddi (CIRAD President Managing Director) and Eduardo Simarriba (CATIE RR)

| FRANCE |

CIRAD-AFD-Expertise France: making things happen in favour of partners in the global South

CIRAD, the Agence française de développement and Expertise France signed a novel framework agreement on 24 February 2020, for tripartite cooperation to further the agroecological transition in the global South.



Left to right: Her é Conan, Deputy Director General in charge of Operations, Expertise France; Michel Eddi, CIRAD President Managing Director; Bertrand Walckenaer, AFD Associate Chief Executive Officer © A. Chrétien, CIR

CIRAD, the Agence française de développement (AFD) and Expertise France (EF) signed a framework agreement at the Paris Agricultural Show on 24 February. It sets a course for four years of collaboration to respond to the major challenges of agricultural and rural development in the global South. The first projects will focus on the Sahel and the French overseas regions. In the short term, they represent nearly 10 million euros of AFD funding.

The three partners share objectives and approaches: sustainable agriculture and livestock farming, food quality, and the fight against deforestation. *“Our three institutions want things for our partners in the global South to change for the better. They expect a lot from us because they are facing complex, difficult situations in which science, expertise and funding are absolutely vital”,* said CIRAD President Managing Director Michel Eddi. For AFD Associate Chief Executive Officer Bertrand Walckenaer, research and expertise are crucial to the success of the agroecological transition in developing countries.

| AFRICA |

Agroecology: a platform to transform farming and food systems

France and CGIAR have launched a new transformative partnership platform (TPP) on agroecological approaches, to inform policy makers and donors in the light of the climate crisis.

The new transformative partnership platform (TPP) is intended to speed up the transformation of food systems by means of agroecology. It was launched by France and CGIAR and is coordinated by CIRAD and the CGIAR FTA (Forests, Trees and Agroforestry) programme, and aims to document the potential of ecological approaches. The platform will be presenting a portfolio of ambitious projects on the agroecological transition. It will respond to the need to change the way in which research is done, to ensure that it is inclusive and adaptive, and integrates stakeholders' knowledge. The first

Agroecological market gardening scheme in Casamance [Senegal] © R.Belmin, CIRAD



project will document and evaluate the socioeconomic viability of agroecological practices across Africa, over three years. It will include a holistic assessment of job creation and work, income and food security outcomes for households. Through a dozen very diverse case studies across the continent, involving numerous partners, the platform will look at the workload and the nature of the work required by agroecological practices, and their impact on ecosystem services.

etienne.hainzelin@cirad.fr

CIRAD has relaunched and broadened its scientific partnership with the Republic of Congo

After 30 years of cooperation focusing on reforestation and then on developing industrial plantations, CIRAD and the Congo Ministry of Research and Innovation have broadened their partnership to cover new fields of study: agriculture, agrifoods, and human, plant and animal health. CIRAD is also planning to provide policy and scientific support aimed at preserving forest peatland zones, which cover almost 150 000 km² between Congo and DRC.

denis.depommier@cirad.fr

| SOUTHEAST ASIA |

CIRAD is to train a new generation of managers

AFD and CIRAD have committed to promote the sustainable management of agricultural and forest plantations, whose expansion has triggered massive biodiversity losses in four member countries of the Association of the South-East Asian Nations.

To prepare the agroecological transition needed by the main tropical plantation chains, CIRAD will be consolidating existing initial and further training systems in four ASEAN member countries. The Agence française de développement (AFD)-accredited project has 1.2 million euros of funding from the Fund for Expertise and Exchanges of Experience (FEXTE). *"We trust CIRAD and its partners in Indonesia, Malaysia, Vietnam and Thailand to work together to define and implement training actions for the new generation of plantation managers, farmers and even agricultural bankers!"*, says Yazid Bensaïd, AFD Regional Director for Southeast Asia. The ASEAN zone is home to the world's third largest tropical forest, after the Amazon and the Congo Basin. However, the development of large rubber, oil palm and timber plantations has led to significant deforestation and sudden losses of biodiversity.

alain.rival@cirad.fr • philippe.girard@cirad.fr



Mother and baby proboscis monkey (*Nasalia larvatus*), a tree-dwelling monkey of the family Cercopithecidae endemic to Borneo

A. Rival © CIRAD



Technology and business

Satellite images to manage forests

Suzano is Brazil's largest producer of wood for pulp. The company manages 1.3 million ha of planted forests and almost the same area of preserved natural forests in Brazil.

It called on CIRAD to help it with forest management. Reginaldo Gonçalves Mafia, Executive Manager of Forest Management Technology at Suzano, and José Luiz Stape, a researcher and university professor specializing in forests, talk about this partnership.



Reginaldo Gonçalves Mafia, Executive Manager of Forest Management Technology at Suzano, and José Luiz Stape, researcher and graduate programme professor at São Paulo State University UNESP – Forest Science (Botucatu, Brazil)

What does the partnership between CIRAD and Suzano involve?

Reginaldo Gonçalves Mafia and José Luiz Stape: The partnership between CIRAD and Suzano was established in 2020, after six months of discussions and careful planning. The aim is to develop technological innovations to achieve “orbital management” of Suzano’s planted and natural forests in Brazil. The aim of the project is to optimize the management of the forest. This is achieved by using the most advanced sensors and satellite images (CIRAD’s expertise) combined with precise measurements of forest growth (Suzano’s expertise), via machine learning (ML) and artificial intelligence (AI) procedures. The project originated within Suzano’s Technology and Innovation Department, which is committed to digitizing forest management, given: (i) the magnitude of Suzano’s planted and natural forest areas across Brazil; (ii) the increasing complexity of operational decisions given the multitude of information to be considered and analysed; (iii) the biological and environmental aspects, such as climate change, and socio-economic aspects affecting operational and strategic decisions; (iv) the existence and rapid development of new remote sensing technologies and satellites; and, finally, (v) the opportunities for cost reduction and better use of natural resources. CIRAD was chosen as a partner based on two main aspects: (i) CIRAD’s vision of science (an applied science), its laboratories specialized in remote sensing (TETIS Joint Research Unit) and its connection with other institutes (INRAE) also very much at the forefront of these new technologies; and (ii) the fact that Suzano had already worked successfully with CIRAD teams (Euflux project in Brazil).

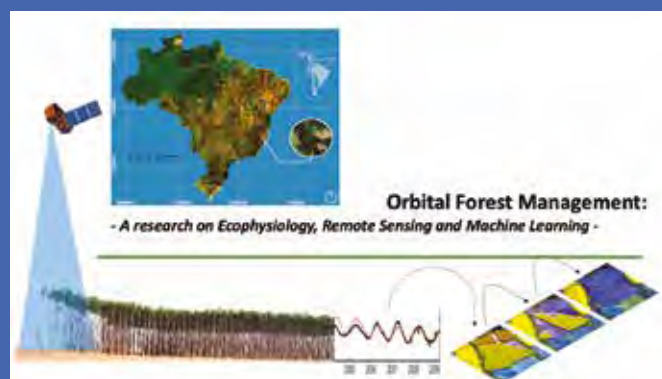
What is the added value of this partnership for Suzano?

RGM and JLS: In addition to providing better and faster management decisions for short- and long-term planning, the project trained Suzano’s technical team. It has also enabled the joint development of tools to quantify forest biomass and carbon sequestration using the company’s inventory system, and to identify the use of archived remote sensing imagery for historical analysis of planted and natural forests. The results obtained, many of which have already been published in peer-reviewed journals, are valuable to the company because they are backed by an independent group of scientists, and can be used by the company in Brazil and other tropical countries.

What are the main lessons and perspectives?

RGM and JLS: The mutual trust and learning between Suzano and CIRAD have been essential to the success of the project. Based on the success of the first phase, Suzano plans to maintain the partnership to ensure full adoption of the technologies developed. The company is now at the forefront of innovation in terms of satellite monitoring, and this will be increasingly important in the face of the most uncertain scenarios in the future.

Interview conducted by e-mail.



This partnership is part of the CiradInnov® dynamic. CIRAD’s offer, promoted under the CiradInnov® banner since 2020, is aimed at all stakeholders who have a direct use for it: start-ups, SMEs and large groups, professional federations, NGOs, local authorities and public agencies.

Platforms in partnership for research and training

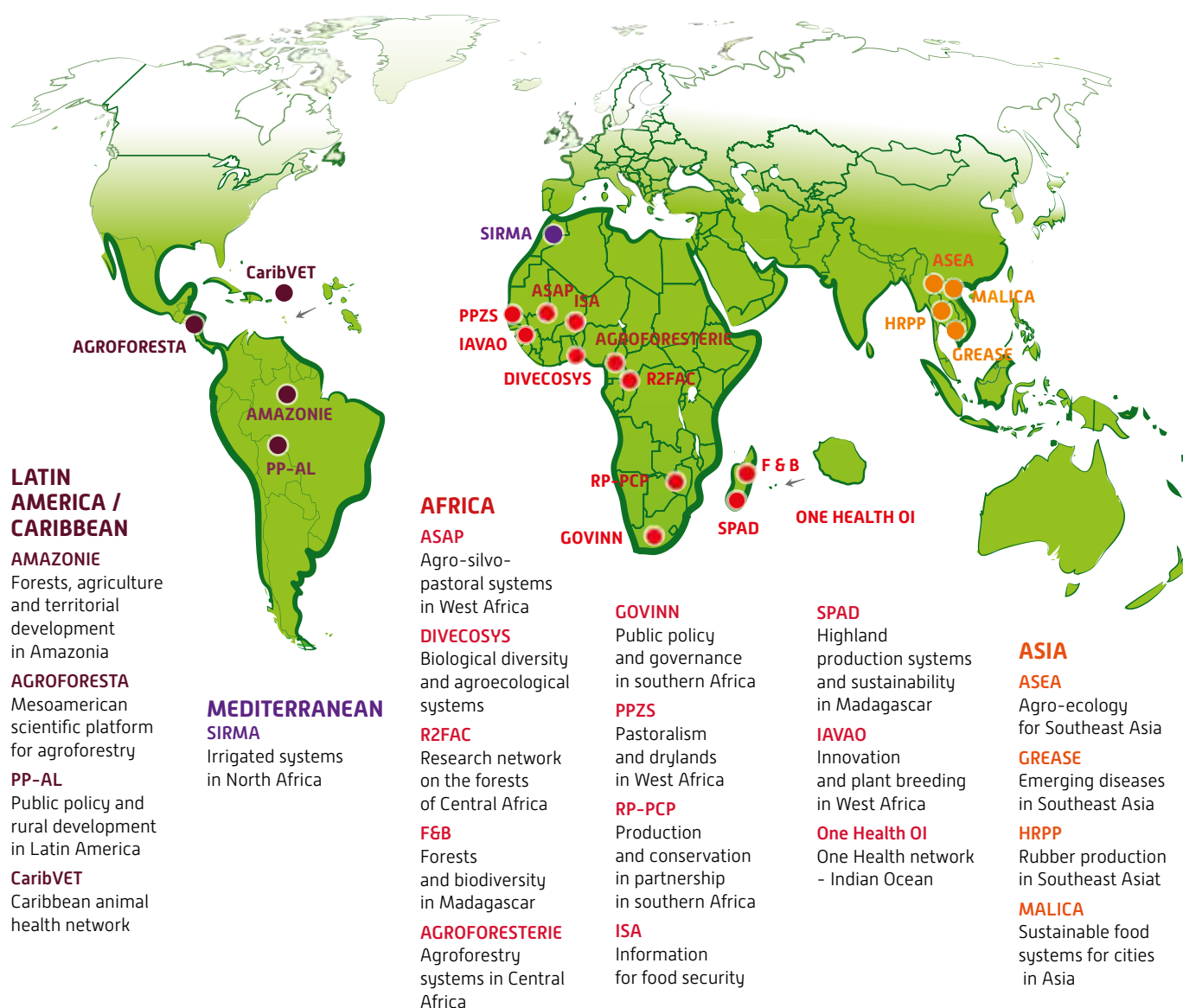
Since 2009, CIRAD has prioritized a novel way of operating over-seas: participating in international «platforms in partnership» (dPs), a tool it has developed and implemented with its partners. This reaffirms its commitment, through medium- and long-term contracts, to research, innovation and training platforms built and managed jointly with a range of partners. CIRAD is currently a member of more than 20 platforms, to which it assigns researchers, and which each involve up to 30 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, as was the case for RP-PCP in 2020 [see interview opposite].

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 over-seas regions.



RP-PCP, time to take stock

2020 was a year like no other, particularly for international structures involving a range of partnerships, but it was a fruitful one for the Production and Conservation in Partnership in Southern Africa platform in partnership for research and training (RP-PCP). In addition to an external audit, RP-PCP also undertook a self-audit, examining its impact by means of the ImpresS method. Platform co-coordinator Prisca Mugabe tells us more about the two operations.



Prisca H. Mugabe is Associate Professor at the Faculty of Agriculture, Environment and Food Systems, University of Zimbabwe. With CIRAD's Alexandre Caron, she is co-coordinator of the Production and Conservation in Partnership in Southern Africa platform in partnership for research and training (RP-PCP). RR

What does the RP-PCP partnership consist of?

Prisca Mugabe: RP-PCP consists of several categories of partners, namely: universities in Zimbabwe (UZ, NUST, BUSE, CUT, LSU), a regional university (University of Zambia) French research organizations (CIRAD, CNRS), and new approved members: national, regional (from Mozambique, Botswana) and IRD. The French Embassy was initially the main funding partner and the French ambassador still chairs our Advisory Board. We collaborate with communities and government departments such as local government, veterinary services, Zim-parks and agricultural extension.

RP-PCP in a nutshell

The "Production and Conservation in Partnership" research platform (RP-PCP) was formally established in 2007. RP-PCP focuses on protected areas and neighbouring production zones in southern Africa, with the ambition to improve the coexistence of agricultural production and conservation of natural resources for the benefit of rural communities. It does so by strengthening national research capacity, multidisciplinary approaches and institutional partnerships.

RP-PCP was audited in 2020, how did that go?

PM: The RP-PCP evaluation was part of a well-defined governance structure, involving a Memorandum of Understanding renewed every five years. The Advisory Board meeting of 2019 approved the 2020 internal and external evaluation. The external evaluation was implemented between April and December 2020 by three evaluators selected for local, regional and international expertise. The Covid-19 pandemic affected the process with no physical meetings possible, yet the evaluation went well... We were happy with the evaluators' thoroughness in spite of the challenges. The evaluation document gives recommendations for the short and long term. It highly commended the research and capacity building work of RP-PCP and among the recommendations was that it needs to be more gender inclusive and to have a robust communication strategy.

Concurrent with the external evaluation, RP-PCP carried out an internal evaluation using an adaptation of the ImpresS *ex-post* methodology, and has further embarked on ImpresS *ex-ante* processes to define the vision and strategies for impact for the future.

How about the impact analysis through the ImpresS method?

P. M.: The CIRAD ImpresS method provides a very useful way of looking at impacts with two main processes, namely *ex-post* and *ex-ante*. The *ex-post* approach was really good because we needed to look back and reflect. The only problem was we did not have a robust framework for evaluation and so the retrospective analysis was mainly through individuals with a longer institutional memory. We administered a questionnaire and had respondents from different areas of involvement and specialization on what the RP-PCP innovation has been: innovation process, main achievements, etc. Then we went into the *ex-ante* method: looking into the new MoU and beyond. We will use it to define the platform within the next 5 to 15 years in terms of plausible pathways for the impacts we want to contribute to. A series of five workshops are planned to do this, between April and June 2021.

Interview by video link, 16 April 2021.

Human/livestock/wildlife interfaces in southern Africa
© Irene Karuya (Harare, Zimbabwe)





Governance



& Strategy

Behind the mask, a fully supportive organization

"You've done an amazing job, I'm proud of you", said CIRAD President Managing Director Michel Eddi on 11 May 2020, almost two months to the day since the announcement of what is now known as "the first lockdown". Responsiveness, mobilization and commitment are no doubt the watchwords for 2020, for an organization that has adapted and proved capable of fulfilling its remit without giving up its values of solidarity and sharing.

As this report goes to press, it is difficult to remember the atmosphere the day after the first lockdown was announced, in France, obviously, and at CIRAD in particular. We have grown used to living with the virus and the threat of the disease, and have largely forgotten the uncertainty, and even the fear, that gripped most of us. At CIRAD, as soon as the pandemic began, General Management set up a specific crisis unit, which met remotely on a regular basis, indeed as often as twice a day at the start of the crisis. Alongside that first unit, a second was set up to decide on the instructions and measures required in the French overseas regions. The two were subsequently merged to increase efficiency. The aim was to safeguard the health of CIRAD's staff as far as possible, while ensuring the continuity of CIRAD's essential activities.

The prime concern for General Management: staff wellbeing

Right from the start of the pandemic, and throughout the year, CIRAD General Management was determined to support each and every one of its teams. This of course meant its staff in France, particularly the most vulnerable, but also its expatriates, many of whom found themselves in extremely complex situations. Our interns and students from tropical and Mediterranean countries also faced huge obstacles, with many feeling isolated and unsure.

Between 16 March and 31 December, some forty news items about Covid-19 were published on CIRAD's Intranet. Over the same period, Michel Eddi spoke officially to our staff nearly ten times, generally by video link, to explain things, reassure and listen to them, and keep up morale despite the context. The words empathy, listening to each other, and patience were heard over and over again. Michel Eddi also spoke to CIRAD's partners, to forcefully reiterate the organization's commitment to solidarity, in view of the particularly difficult situation in some countries.

Concrete steps

After a strict lockdown, during which CIRAD staff were helped to work from home, the return to onsite working in mid-May was prepared scrupulously. Floor markings, sanitizer dispensers, reorganized conference rooms, and so on... in Paris, Nogent-sur-Marne, the French overseas regions and Montpellier, our technical teams worked tirelessly to ensure everyone could come back to work safely. However, teleworking, which had been a rarity at CIRAD prior to the pandemic, subsequently became the rule once again, for those activities that allow it. At the same time, training courses were rolled out to help teams work from home in the best possible conditions, covering successful teleworking, work-life balance and ergonomics, amongst others. These were all online courses, and a large number of employees took up the offer.

Solidarity, both in house and beyond

CIRAD's social development unit within its Human Resources Service has linked up with outside psychologists to offer support for those who need it. Staff have been on full pay throughout the crisis, including those exempted from working due to being unable to work from home. The support staff who prepared and restructured CIRAD's premises while respecting the various protective measures were given a bonus, to recognize their efforts.

CIRAD encouraged its teams to donate masks, gowns, caps, gloves, safety goggles and overshoes to the local university hospital, to support medical staff and their patients. This drive, which was initially spontaneous but subsequently coordinated, allowed us to provide several thousand masks, gloves and other items for use in the fight against Covid-19, at a time of serious shortages. In Guadeloupe, at the request of the Prefect, CIRAD has carried out PCR tests.

More than a year after the pandemic began, one thing is sure: CIRAD has kept calm and carried on, and our order book is looking healthy. A sign of our resilience.



Axel Kahn, a committed Chair of the Ethics Committee

With three statements to his credit – on ‘genetic modification of animals in the light of genome editing’, ‘the latest plant genetic improvement techniques’, and the ‘ethical dimension of the major international agreements’ – Axel Kahn renewed his mandate as Chair of the INRAE-CIRAD-IFREMER-IRD Joint Committee on Ethics (C3E4) in 2020. The geneticist talks about his involvement in the Committee.

What links do you have with CIRAD as Chair of the Joint Committee on Ethics?

Axel Kahn: I have the same relationship with the CEO of CIRAD as I do with those of the three other Joint Committee organizations. Yet the bond is somewhat special because CIRAD is one of the most long-standing Ethics Committee partners, but also because I have known Michel Eddi for a very long time, before he became CIRAD’s President Managing Director, and before I was Chair of the Ethics Committee. Lastly, these ties are of a special nature because CIRAD is a source of inspiration in certain areas of the reflections, work and opinions of the C3E4.

What motivated you to extend your chairmanship of this Committee in 2020?

AK: I was excited by the work and reflection undertaken during my first mandate. In fact, I have been deeply interested in environmental and agricultural issues for decades. I was Chair of the Biomolecular Engineering Commission at the French Ministry of Agriculture and Fisheries from 1988 to 1997 and have remained very much involved in these issues. The environment is a key concern for me in terms of the associated ethical issues. At the close of my first mandate, I wanted C3E4

to advance and hence put forward three requests:

- that the Committee be more focused on the general public and its concerns
- that the international scope of the statements issued be stressed. That they initially be translated into English and then also into Spanish
- that the relationship between the Committee and the research institutions it serves be less institutional. Currently only CEOs can refer to the Committee. I wanted researchers from CIRAD and other organizations to be able to express their concerns. I therefore suggested creating a specific website for real-time dialogue with the staff of the four organizations.

These requests were approved, so I had no reason to refuse a new mandate, which I accepted for the next four years.

In your opinion, what is CIRAD’s specific role in this joint INRAE-CIRAD-IFREMER-IRD Committee?

AK: As I mentioned earlier, CIRAD is a source of inspiration for the Committee. Its specificity is reflected in its title – the French Agricultural Research Centre for International Development –, and I will focus on the international dimension, which underpins the diversity of cultures

considered. All of our thinking on the diversity of viewpoints is greatly enhanced by taking cultural diversity, viewpoints, temporal perspectives, etc., into account. This forces us out of our usual mindset to help us comprehend the reasoning that prevails in the tropical and Mediterranean countries with which we work. Foreign scientists have very interesting ideas that often inspire C3E4 reflection

Does C3E4 have a special role to play in the current setting?

AK: The Committee did not address the Covid-19 issue. I spend my days doing that, but on an *intuitu personae* basis. We have not specifically addressed this situation. Yet this question brings to mind our statement on ‘the ethical dimension of major international agreements’, where the Ethics Committee underlines the importance of one pivotal element – discussion and international cooperation. The initial response to the Covid-19 outbreak was ‘every man for himself’, even in Europe, and worldwide, which was disappointing. A rebuilding process in favour of more trusting and interactive cooperation is therefore now essential.

Interview by video link, 8 April 2021

CSR – Towards a road map for sustainable development and social responsibility

In 2020, CIRAD began drafting a road map for sustainable development and social responsibility (SD&SR). The aim is to prioritize and set out its intentions and contributions in favour of open, useful and supportive research, to foster sustainable development. The second objective is to promote ethical debate and consideration of environmental and social issues within the organization.

Over the past year, which has been a year apart due to the Covid-19 pandemic, the CSR project has progressed along four main lines: travel, energy policy, quality of work life and open science. The health crisis triggered by Covid disrupted all previous practices, and the need to analyse its impacts – both negative and positive – is inevitably fuelling our work.

Towards more responsible travel

Travel is the main source of CO2 emissions at CIRAD (more than 70% of the total in a standard year, of which 80% can be put down to air travel). General Management has therefore identified reducing the carbon footprint of local travel (home-work and between sites) and non-local business travel as a key element in its low carbon policy.

A charter setting out the principles and values behind our commitment, in the hope of finding the best possible way of regulating travel and limiting its environmental impact, is being drafted. We are also working on an institutional transition project aimed at:

- Building awareness of the impact of business travel on climate change, both in house and with our partners;
- Revising our travel decision-making and selection process, to encourage greater environmental and social responsibility;
- Developing eco-engineering of project activities involving partners and donors;
- Improving and applying our accountability system (measurement, goal monitoring, communication).

A virtuous energy policy for 2012-2020, and new ambitions

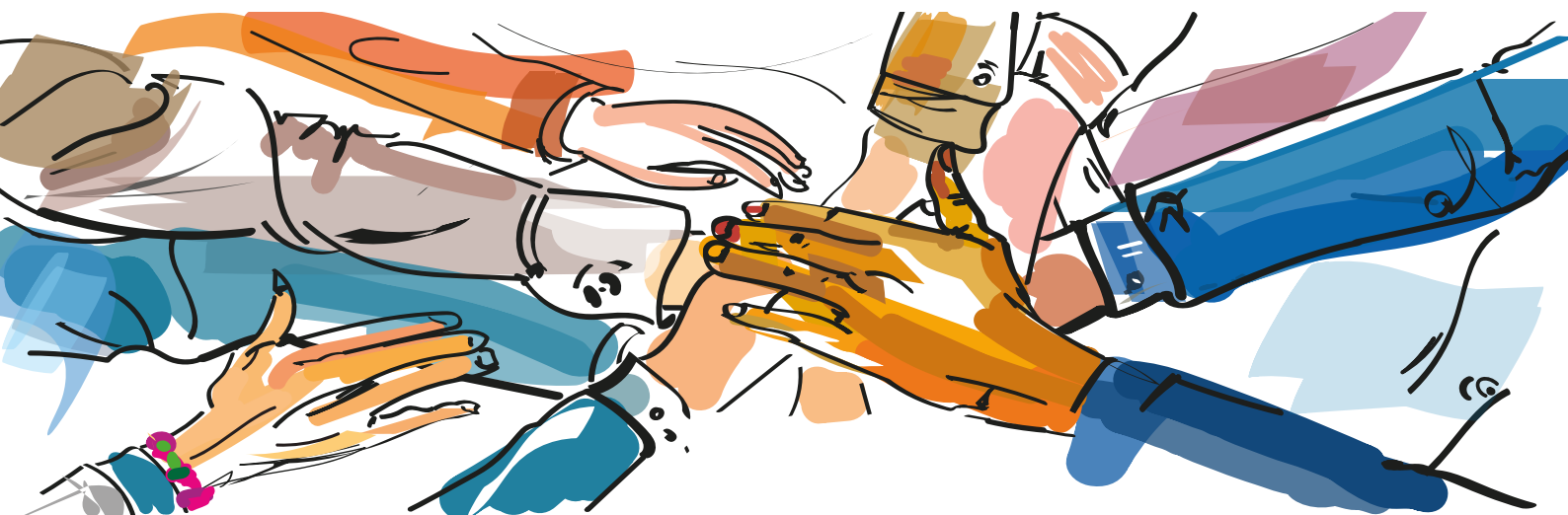
We have met the targets set in our 2012-2020 energy policy, with a drop of 10% in electricity consumption, 20% in heat consumption and 18% in greenhouse gas emissions under the energy heading. Looking ahead, CIRAD is working to set new 2030, 2040 and 2050 energy targets that fit in with the national low carbon strategy, "loi Élan" and circulars on "exemplary administrative services" and "eco-responsible public services".

CIRAD has been granted funding for seven energy saving projects in metropolitan France and the overseas regions, under State stimulus packages covering lighting, insulation, heating and cooling networks and installation of solar panels.

In Montpellier, the Eco-Site Lavalette project, the most ambitious renovation project in CIRAD's history, has been registered for the 2021-2027 State-Region contract. The project is exemplary in terms of energy efficiency, environmental impact and quality of work life. In particular, it includes the building of a positive-energy building, renovations, demolition of energy-inefficient buildings, etc.

In Réunion, the renovation-building operation at the plant protection platform (3P), due to be completed in mid-2022, is a very ambitious low-carbon, energy-saving, climate-smart project.

Since 1 January 2020, plastic cups for drinking fountains have been banned (100 000 cups were used each year prior to the pandemic). In the light of Covid-19, a system of box lunches has been rolled out in Montpellier, using compostable containers.



A barometer to measure quality of work life



CIRAD is drafting a teleworking agreement* to last beyond the exceptional situation resulting from the pandemic. It has also begun building a social barometer, to enable it to measure the

impact of its programmes in terms of quality of work life, revise them if necessary, and fuel corresponding policy.

*Agreement signed on 31 May 2021.



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Open science and higher education and research partnerships in favour of CSR

CIRAD is building its open science and research data policy. In 2020, it appointed a CSR policy officer to support changes in its commitments and the corresponding support structure, in association with our partners.

CIRAD has also confirmed its commitment within several inter-organization research infrastructures, open science and data "FAIR-ization**" instruments relating to the environment: the French element of AnaEE Europe (Analysis and Experimentation on Ecosystems), the national biodiversity data repository (PNDB) and the naturalist collections network (ReColNat).

The QuaRES association for quality in research and higher education, chaired by CIRAD, has modified its statutes to include promotion of and support for social responsibility within the sector. Lastly, its work on more responsible research and innovation – in association with the *Conférence des grandes écoles*, the *Conférence des présidents d'universités* and many other higher education and research players – has resulted in the revision of the "SD&SR" label.

** The fact of applying "FAIR" principles (Findable, Accessible, Interoperable, Reusable) for research data management and sharing.



2020 Indicators

The indicators to monitor progress on the establishment's Scientific and Partnership Strategy Objectives were negotiated with the line ministries in 2019. Nine indicators were thus determined with a view to updating our Contractual Objectives:

Indicator 1 • Scientific output

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

Indicator 3 • Number of senior scientific staff members on assignment (by major geographical area)

Indicator 4 • Number of assignments undertaken by staff (in FTEs) by major geographical area (available from 2021)

Indicator 5 • Number of PhD students from the global South/total number of PhD students supervised by CIRAD researchers

Indicator 6 • Job structure – permanent contracts, fixed-term contracts, grant-funded PhD students –, number of FTEs [%]

Indicator 7 • Distribution of staff members by gender and category

Indicator 8 • Orders registered for the year (DFI and turnover for project portfolio, M€) per type of donor

Indicator 9 • Results of contractual activity for the year (DFI and turnover, M€) per type of donor

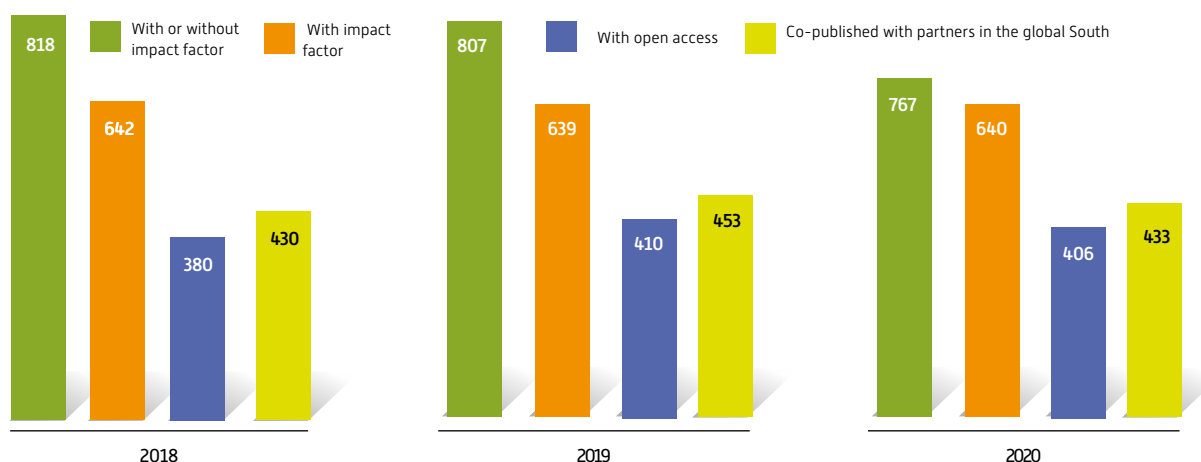
THE SCIENCE AMBITION

Scientific output is one of the permanent indicators [indicators 1 and 2]. The 2020 results show volumes of publications and co-publications similar to those in the previous two years. The indicators for quality, open access and co-publication with our partners have improved.

Since the signing of the Berlin Declaration in 2006, CIRAD has been fully committed to a policy of free open access to its outputs [indicator 1]. For instance, in 2020, more than 111 482 resources were available on Agritrop, CIRAD's open archive platform (<https://agritrop.cirad.fr>), and 53% of full-text, peer-reviewed articles deposited

on Agritrop could be freely consulted on-line by the public at large. This result bears witness to CIRAD's commitment to open science and to shared global science, which resulted in 265 000 on-line consultations and 2 377 534 downloads of scientific documents..

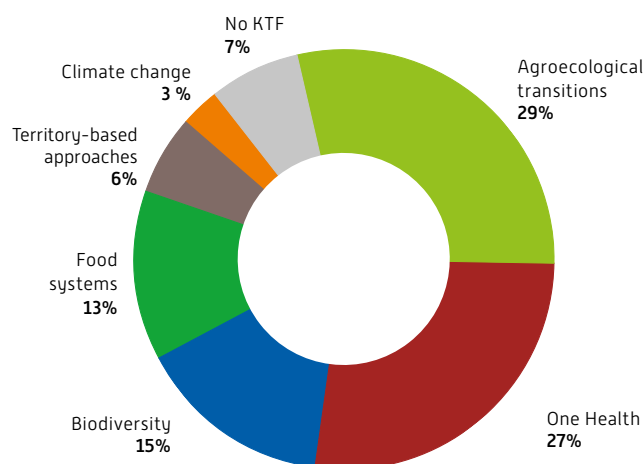
Number of peer-reviewed articles, with or without impact factor



Source : Agritrop. Dist – DGDRS

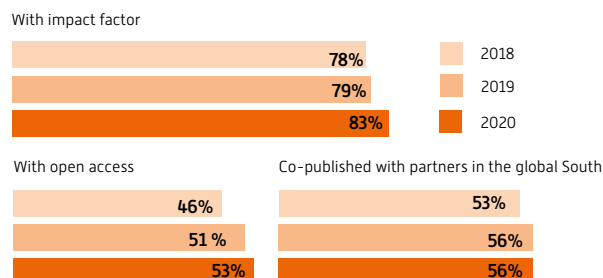
In 2020, the breakdown of scientific outputs by key thematic field (KTF) placed Agroecological Transitions in pole position at 29%, followed by Health at 27%, then Biodiversity and Food Systems at 15 and 13%, respectively.

Distribution of publications by Key Thematic Fields (KTF)



Source: AGRITROP. DIST – DGDRS

Scientific output trends for peer-reviewed articles



Source: AGRITROP. DIST – DGDRS

THE PARTNERSHIP AMBITION

The overall decline in the geographical mobility of CIRAD staff seen in 2019 worsened in the severe Covid-19 context, reducing the number of CIRAD researchers operating abroad and in the French overseas regions (DROMs) to 284 full-time equivalents (FTEs). That number remained predominant and stable in the DROMs (120 FTEs, or almost 42%) and held steady for sub-Saharan Africa (93 FTEs, or 33% of staff) (indicator 3). These two major regions account for almost 3/4 of our overseas presence. There has been a major upturn for Southeast Asia and Latin America, with significant growth in staff of almost 50% compared to 2019. The target set is 335 FTEs present in the field, alongside our partners, with ongoing efforts for the African continent.

The number of platforms in partnership stands at 21 in 2020, with 12 located in Africa and the Indian Ocean, four in Latin America, four in Asia and one in the Mediterranean. CIRAD is also operational in three international joint laboratories (IJL) to which it belongs.

Indicator 4 on assignments conducted by broad geographical area will only be produced from 2021, with a new database (information system currently being updated).

Number of senior scientific staff members on assignment by major geographic area (in FTEs)

Sub-Saharan Africa	92.84
North Africa	6.14
Asia	25.39
Oceania	1.00
South America	17.22
Central America and the Caribbean	13.48
North America	2.50
French overseas regions	120.40
Europe	5.21
TOTAL	284.80

Source: SIRH - DGDRO.

THE TRAINING AMBITION

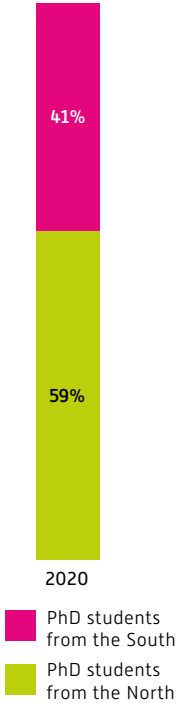
The “Training in the South, with the South and for the South” ambition is one of the key changes in CIRAD’s new Strategic Vision compared to the previous version. This shift arises from the realization that no development is possible for a country without the human capital needed to plan and implement it, which leads most of CIRAD’s partners to request its support to help them meet their needs.

The quality of student hosting remains a key objective for CIRAD. With the global Covid-19 pandemic in 2020, CIRAD was only able to host and supervise 15 PhD students from tropical and Mediterranean countries (indicator 5) compared to 230 in 2019, despite a stable number of applications (238). Fortunately, this indicator has had no impact on scientific co-publications (indicator 2), which accounted for 56% of our peer-reviewed publications.

Closer involvement with the Montpellier SupAgro institute led to a project in 2020 for a new joint support unit for teaching and training engineering in the global South (Pollenis) (for further information, see page 34). Along with the Pollenis Unit, CIRAD has also worked on two proposals for the AFD call for projects on “Partnerships with African Higher Education”. Two projects, “Promouvoir un enseignement supérieur professionnalisant ancré dans les territoires pour accompagner la transition agroécologique des systèmes alimentaires au Sénégal (Promoting territory-based higher vocational training to assist the agroecological transition of food systems in Senegal)” (Pettal) and “Renforcement de la démarche compétences et de la culture entrepreneuriale dans la formation supérieure agronomique : leviers pour l’insertion professionnelle et le développement de la bioéconomie au Bénin (Strengthening the skills drive and enterprise culture in agricultural higher education: levers for vocational integration and development of the bioeconomy in Benin)” (Biovalor) have been short-listed for a final decision in June 2021.

To meet the many expectations of its partners, and its training ambition, which is not its primary activity, CIRAD is strengthening its links with French higher educational establishments targeting Africa as a priority international development zone. It draws up joint proposals on various levels, particularly with colleges belonging to the Agreenium consortium (Montpellier SupAgro, AgroParisTech and ENVT), but also with other academic bodies, foremost among which is the University of Montpellier, as part of the MUSE I-Site. The global health crisis has led to the development of e-learning, such as the AgroParisTech Soil and Climate MOOC, to which CIRAD has contributed

PhD students supervised by CIRAD



THE INNOVATION AND IMPACT AMBITION

Since 2010, the CIRAD ImpresS team has been fostering an impact culture, both in-house and with its partners, promoting collective reflexivity and learning on how research contributes to the innovation processes in which CIRAD is involved. Its scientific and methodological work underpins a critical reflection on the role of research and how it contributes to lasting impacts. It enquires into changes in the practices, behaviours and interactions of actors. The ImpresS approach and its tools are applied to in-house projects and roadmaps, and to certain platforms in partnership (dPs). These activities are run by the ImpresS team, based at the Research Impact and Marketing Service (DIMS), working in close liaison with the Innovation joint research unit, combining assistance and research operations. By being part of these in-house deliberations, ImpresS plays a role in setting CIRAD's position in international debates on understanding complex relations between different types of knowledge, and on the role of knowledge, science and technology in social transformations at the interface of science and society, and science and politics.

In 2020, the team had to rethink how it operated in a health crisis context (on-line workshops and participatory training), but it continued to develop and strengthen the impact culture. The team (having doubled in size) worked alongside the teams of numerous research units in constructing impact pathways for their operations, bringing into play "ImpresS *ex-ante*" on different levels (ten

projects, two supply chain roadmaps – cocoa and plantain banana, and the beginnings of a strategy for a platform in partnership). In terms of "ImpresS *ex-post*" aspects, four cases were launched at the beginning of 2020, with a further three at the end of the year. A thorough analysis has been made of the monitoring-evaluation skills needed (notably for projects), to propose assistance and training formats tailored to the needs of the establishment. Lastly, a community of practices on "change-oriented approaches" has been outlined, for actual launch in 2021, which will enable CIRAD's staff and its partners interested in these approaches to discuss them, test the methodology and benefit collectively.

Lastly, in 2020, the DIMS Donors and Impact Unit set about designing a corporate advocacy strategy, which it will continue to work on in the coming years.

The CIRAD in-house Science and Societies task force, with its highly diversified members, combining research and support services, has continued its deliberations on how to renew relations between science and society. A position paper will be issued at the beginning of 2021 with some concrete proposals on new ways of implementing research in partnership. It will consolidate this ambition within CIRAD, by more effectively integrating the diversity of societies and stakeholders in tropical and Mediterranean countries, in a more civic, inclusive and ethical way.

ALIGNING RESOURCES POLICY WITH THE SCIENTIFIC AND PARTNERSHIP STRATEGY

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

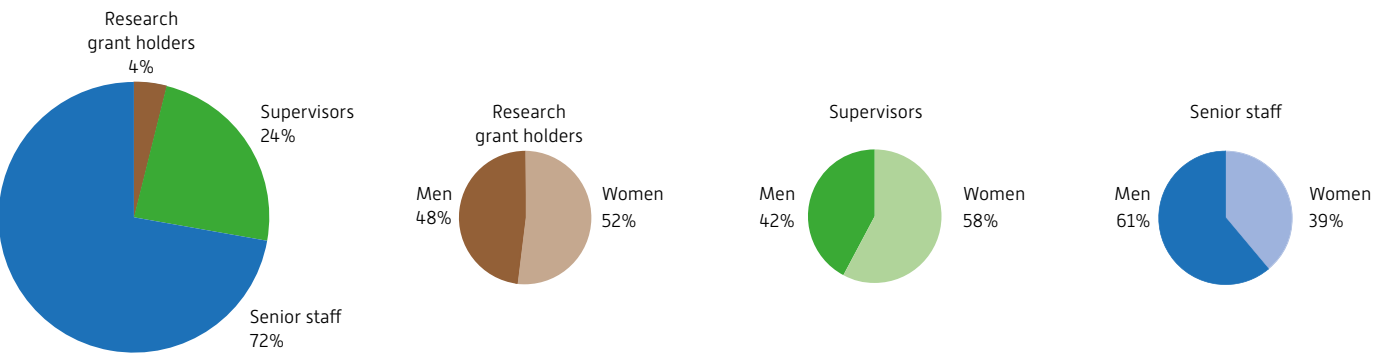
The challenge is not merely to guarantee the level of resources "required" for CIRAD to conduct its activities. It is also, and above all, to guide support functions and ensure, wherever possible, that they are in phase with the establishment's strategy.

In 2020, CIRAD relaunched a dynamic employment policy to strengthen the capacities needed for its scientific and geo-partnership strategy, with 77 open-ended contract recruitments. However, despite an upturn, the effort devoted to making up for

the decline in staff numbers at CIRAD was not conclusive in 2020, though it is worth noting that the number of open-ended contracts has been stabilized, after several years of decline.

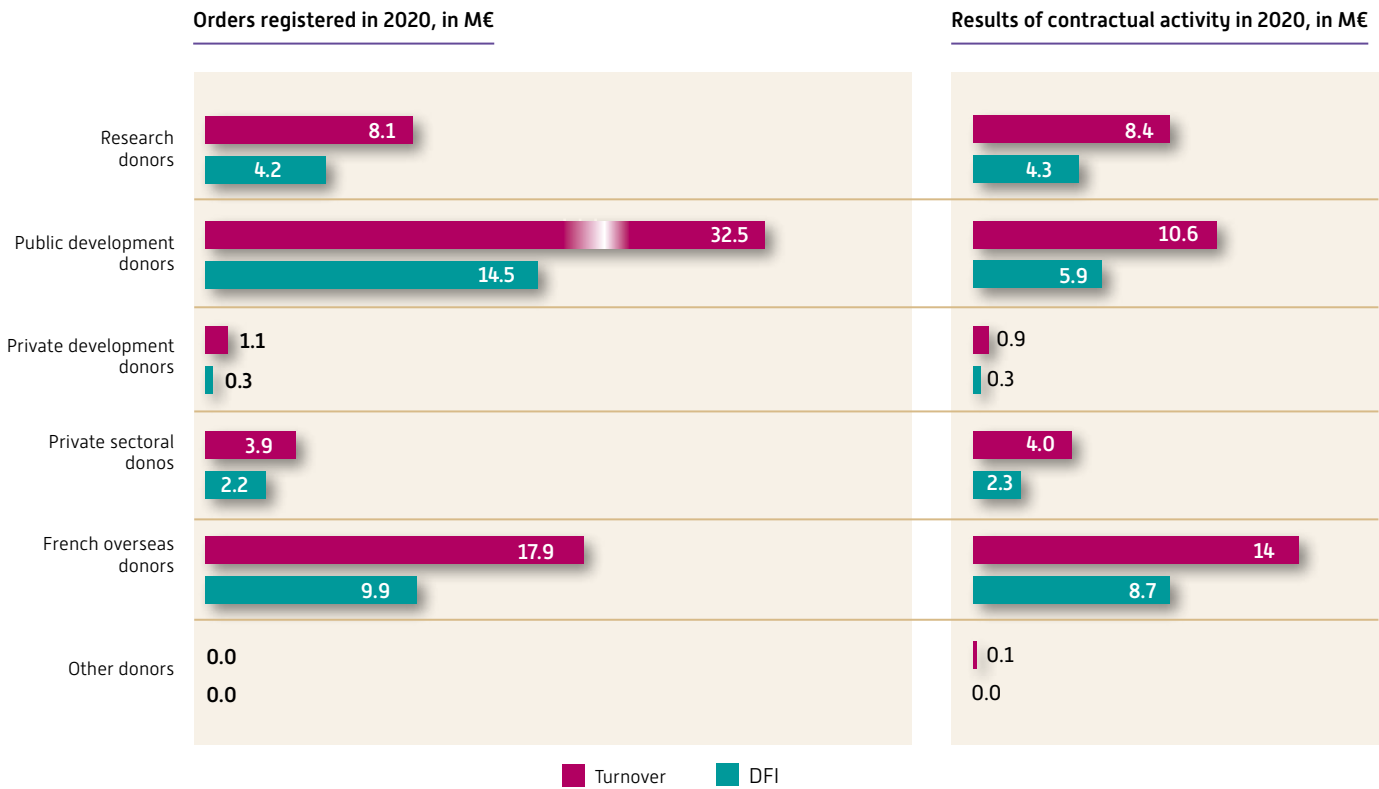
The share of research grant holders, which has reached virtual gender parity, has remained steady, with 4% of staff numbers. The share of "agents de maîtrise" (supervisors) is steadily decreasing, with a quarter of staff numbers, primarily women (59%). The share of "cadres" (senior staff) has risen following the recruitment drive in 2019, with early signs of parity rebalancing. Progress towards parity is generally slow (44.5% women, 55.5% men), with disparities depending on jobs and categories, to the advantage of women among the supervisors, and men among the senior staff (indicator 6).

Distribution of staff members by gender and category



The new financial indicators produced for the Contractual Objectives concern the orders registered (mostly public development donors, with several DeSIRA contracts [EU DG DevCo and AFD]) (indicator 8) and outputs (indicator 9). Orders registered (indicator 8) are very dynamic, with their contribution to the Direct Financial Impact (DFI) expected to double. For outputs (indica-

tor9), a drop in turnover (€ 38M) is expected compared to 2019, though with a share of DFI (56%) up by 5% on 2019. The contribution made by public development donors and the French overseas regions remains substantial, in line with the existing contracts in the previous year. That of research donors has held steady.



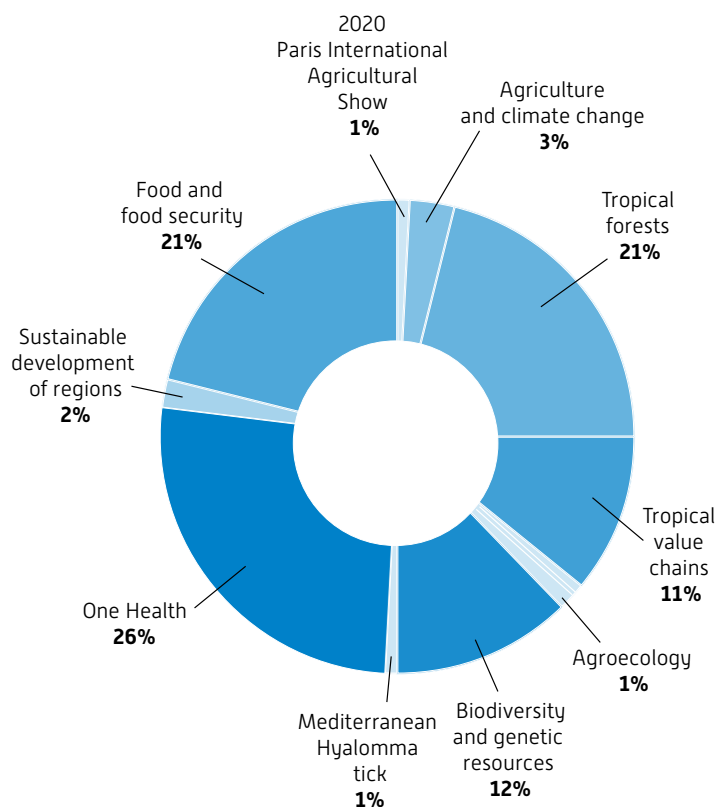
Media and social networks: a renewed presence

CIRAD has a strong presence in the media and social networks thanks to its proactive communication policy and increased resources in 2020.

Media: greater visibility, particularly in the English-language media

Journalists are increasingly calling on CIRAD with regard to major global issues (+50% compared with 2019).

In 2020, we responded to 360 journalists' queries and produced 65 press releases (+25% compared with 2019). Overall, CIRAD was cited 3000 times in the online media in more than ten languages.



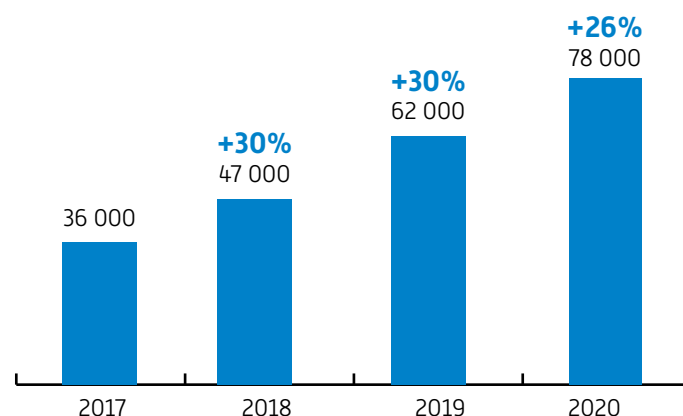
Distribution of CIRAD citations in the French media in 2020
(in advertising equivalency) by topic

Forests and value chains account for one third of the articles selected in CIRAD's media panorama, health for a quarter and food security for a fifth. More than 10% specifically addressed biodiversity issues.



Social networks: strong subscriber growth

With a presence on three social networks – Twitter, LinkedIn and Facebook – CIRAD has experienced strong growth in its subscriber communities over the past 3 years, and 2020 confirmed this trend with a 26% increase, thereby boosting our community to 78 000 subscribers.



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Nathalie Cialdella

Françoise Gérard

François-Régis Goebel

Thibaud Martin

Laurence Ollivier

Émilie Klander, secretary

Participants as of right,
in an advisory capacity

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William's Daré

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Ivory Coast; Professor of Microbiology

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adviser to CNRS General Management

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Deputy Director, Institut des Sciences Sociales
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Accounts and Finance Services

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Claire Roche, Deputy Manager, Human
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Joël Sor, Manager, Information Systems

Élisabeth Subirats, Technical Manager,
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Alexandrine Rey, Deputy Head, Legal Affairs

Yann Combet, Head, Archives Office

Malaurie Salles, Head of Purchasing

Pierre-Jean Ballard, Head, Internal Auditing
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Tiffany Gastineau, Head of Health and Safety
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Alain Billand, Manager,
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Jean-Michel Sers, Head, Europe Office

Tanguy Lafarge, Head of Partnerships

Marie-Claude Deboin, Head of Scientific and
Technical Information

Danielle Lazuttes,
Head of Incentive Operations

Cathy Grevesse, Head of Quality, Social
Responsibility and Research Infrastructures

François-Xavier Côte,
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Jean-Marc Bouvet, Regional Director,
Southern Africa and Madagascar

Denis Depommier, Regional Director, Central
Africa

Christian Cilas, Regional Director,
West Africa - Forest and Humid Savannah

Sylvie Lewicki, Regional Director,
West Africa - Dry Zone

Serge Marlet, Deputy Regional Director,
West Africa - Dry Zone

Pierre Gard, Regional Director, East Africa

François Roger, Regional Director,
Continental Southeast Asia

Alain Rival, Regional Director,
Southeast Asian islands

Jean-Luc Battini, Regional Director,
Brazil and Southern Cone Countries

Denis Gautier, Regional Director,
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Central America and Andean countries

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Montpellier Interdisciplinary center on Sustainable Agri-food systems (social and nutritional sciences) (UMR MOISA)

Mediterranean and Tropical Livestock Systems (UMR SELMET)

Water Management, Actors, Territories (UMR G-EAU)

UMR: Joint research unit • UPR: Internal research unit • US: Service unit

ÎLE-DE-FRANCE

42, rue Scheffer
75116 Paris - France
Tel.: +33 1 53 70 20 21
drif@cirad.fr

MONTPELLIER-OCCITANIE

Avenue Agropolis
TA 178/04
34398 Montpellier Cedex 5
France
Tel.: +33 4 67 61 49 34
dr-mo@cirad.fr

**MEDITERRANEAN
AND MIDDLE EAST**

Avenue Agropolis
TA 179/04
34398 Montpellier Cedex 5
France
Tel.: +33 4 67 61 49 47
denis.gautier@cirad.fr

**CONTINENTAL
SOUTHEAST ASIA**

Cité diplomatique de Van Phuc
Bureau 102, Bâtiment 2G
298 Kim Ma
Hanoi
Vietnam
Tel.: +844 37 34 67 75
francois.roger@cirad.fr

**FRENCH WEST INDIES,
FRENCH GUIANA AND CARIBBEAN**

Station de Neufchâteau
Sainte-Marie
97130 Capesterre-Belle-Eau
Guadeloupe
Tel.: +590 5 90 41 68 68
dir-reg.antilles-guyane@cirad.fr

**MEXICO, CENTRAL
AMERICA AND
ANDEAN COUNTRIES**

Avenue Agropolis
TA 179/04
34398 Montpellier
Cedex 5
France
Tel.: +33 4 67 61 56 37
guy.henry@cirad.fr

**BRAZIL AND
SOUTHERN CONE
COUNTRIES**

Predio FINATEC
Campus Univ Darcy
Ribeiro
Caixa Postal 4522
CEP. 70842-970
Brasília-DF
Brazil
Tel.: +55 61 33 66 16 01
brasil-conesul@cirad.fr

**WEST AFRICA
DRY ZONE**

37, avenue Jean XXIII
BP 6189
Dakar-Étoile
Senegal
Tel.: +221 33 822 44 84
sylvie.lewicki@cirad.fr

**WEST AFRICA
FOREST AND
HUMID SAVANNAH**

Université
Houphouët-Boigny
Cocody, Bâtiment IRD
01 BP 6483
Abidjan
Ivory Coast
Tel.: +225 07 22 48 18 41
ciradci@aviso.ci

CENTRAL AFRICA

Rue Joseph Essono
Balla
BP 2572
Yaoundé
Cameroon
Tel.: + 237 222 21 25 41
cirad-cm@cirad.fr

**SOUTHERN AFRICA
AND MADAGASCAR**

Ampandrianomby
BP 853
Antananarivo 101
Madagascar
Tel.: +261 20 22 406 23
+231 32 07 235 95
dregion@cirad.mg

EAST AFRICA

C/o ICRAF,
United Nations Avenue
Gigiri - PO Box 30677
00100 Nairobi
Kenya
Tel.: +254 207 224 653 / 652
dr.afora@cirad.f

**RÉUNION,
MAYOTTE AND
INDIAN OCEAN
[EXC. MADAGASCAR]**

Station de La Bretagne
40 chemin de Grand Canal
CS 12014
97743 Saint-Denis Cedex 9
La Réunion
Tel.: +262 2 62 72 78 00
dir-reg.reunion@cirad.fr

**SOUTHEAST
ASIAN ISLANDS**

Graha Kapital 1
Jl. Kemang Raya n° 4
Jakarta 12730
Indonesia
Tel.: +62 21 71 98 641 / 642
cirad@idola.net.id

Key figures

1650

staff

200

partner institutions

12

regional office

200

staff members base
outside metropolitan
France

200

million euro
annual budget

800

ongoing projects

CIRAD draws some 35% of its budget from contractual resources generated by its projects, for which the main donors are as follows:

- 32% public research donors (ANR, European Commission, etc.);
- 27% public development aid (Agence française de développement, European Commission, development banks, etc.);
- 26% private donors (R&D);
- 16% local authorities (French West Indies-French Guiana and Réunion- Mayotte).

Find out more about our projects

You can find details of our projects on
www.cirad.fr

Objectives, operations, expected results, partnerships, and funding: around a hundred projects are highlighted, shown on an interactive map.



Publication Manager: Élisabeth Claverie de Saint Martin

Coordination: Marie-Laurence Pouxviel (CIRAD Communication Office)

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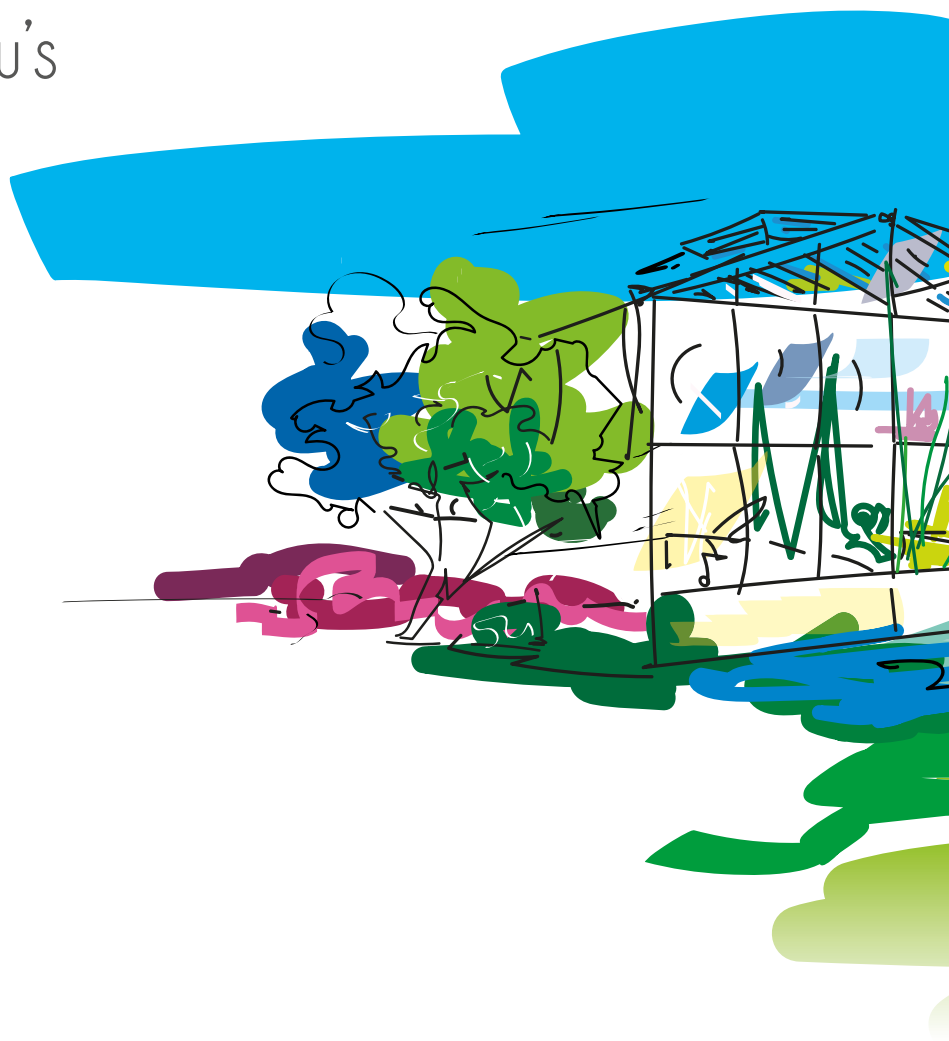
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42, rue Scheffer • 75116 Paris
France

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