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AfricaRice

Partnerships for impact

Africa Rice Center (AfricaRice) – Annual Report 2014

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Cover: Women grading parboiled rice in Malanville IP.

About Africa Rice Center (AfricaRice)

AfricaRice is one of the 15 international agricultural research centers that are members of the CGIAR Consortium. It is also an intergovernmental association of African member countries.

The Center was established in 1970 by 11 African countries. Today its membership comprises 25 countries, covering West, Central, East and North African regions, namely Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Democratic Republic of Congo, Egypt, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Mauritania, Niger, Nigeria, Republic of Congo, Rwanda, Senegal, Sierra Leone, Togo and Uganda.

AfricaRice is implementing its Strategic Plan through the CGIAR Research Program on Rice, known as the Global Rice Science Partnership (GRiSP), the Rice Task Force mechanism and a network of Rice Sector Development Hubs that are being set up across Africa to concentrate R&D efforts and connect partners along the rice value chain.

AfricaRice is headquartered in Côte d'Ivoire. It has outreach stations in Benin, Nigeria, Senegal and Tanzania. Research staff are also based in Liberia, Madagascar and Sierra Leone.

For more information visit: www.AfricaRice.org

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AfricaRice

Message from the Board Chair and the Interim Director General

The '**partnerships for impact**' theme selected for the 2014 Annual Report reflects AfricaRice's recognition of the importance of effective partnership arrangements in successfully responding to agricultural research-for-development challenges both internationally and on the continent. In keeping with its status as an association of member states, the Center has been steadfast in working in partnership. In 2014, with an Interim Director General firmly in place and the Board providing its full support, AfricaRice continued to implement strategic upstream research and capacity-development activities, while proactively linking with development partners to scale out rice technologies to generate impact and outcomes following our theory of change developed in close interaction with our partners in the Global Rice Science Partnership (GRiSP). The progress and successes registered during the year in several areas are highlighted in this annual report.

In 2014, for the first time, the novel idea of an innovation fair was introduced and a 1-day event organized on the AfricaRice Cotonou campus. Several rice technologies produced by AfricaRice ready for scaling out (e.g. mechanical weeders and reapers, 'ASI' thresher–cleaner, RiceAdvice, parboiling stoves, rice briquettes, ARICA varieties and the Smart-valleys approach) were showcased to NGOs, farmers' organizations and development partners. These scalable technologies are captured online in the Center's Rice *e*Hub facility (www.ricehub.org), on video, as rural radio scripts, and written up as one-sheet briefs for distribution.

We feature in this annual report the Center's successful partnership on innovation platforms (IPs: forums where local stakeholders come together to realize a rice business opportunity to improve their livelihoods in a sustainable and equitable manner), established and facilitated in several countries through the European Union-funded 'Realizing the agricultural potential of inland valley lowlands in sub-Saharan Africa while maintaining their environmental services' (RAP) and the African Development Bank-funded 'Multinational CGIAR Support to Agricultural Research for Development on Strategic Commodities in Africa' (SARD-SC) projects. Increased benefits and incomes have been demonstrated by IP actors involved in rice parboiling in the village of Glazoué, Benin, and IP actors involved in mixed farming in the inland valleys in the villages of Doumanaba and Bamadougou in Mali.

We report on AfricaRice's partnership with the French agricultural research organization, Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), and the Madagascan national agricultural research institute, Centre National de Recherche Appliquée au Développement Rural (FOFIFA), to highlight the interesting results emerging from their joint development of integrated cropping systems in Madagascar. Through the practice of conservation agriculture (rice–maize rotation incorporating the legume species *Stylosanthus guianensis*), the menace of the notorious parasitic weed *Striga asiatica* is being thwarted. The crop residue from conservation agriculture provides ground cover to suppress weeds, retains moisture and protects against soil erosion.

The German Federal Ministry for Economic Cooperation and Development (BMZ)-funded 'Mitigating the impact of climate change on rice disease resistance in East Africa' (MICCORDEA) project brings to the fore the work that AfricaRice has been doing on climate change in partnership with the Rwandan, Tanzanian and Ugandan national agricultural research systems (NARS) and German universities. The distribution and severity of two rice diseases, bacterial blight and blast, in Rwanda, Tanzania and Uganda were mapped over a 3-year period to establish baseline data to measure changes in disease patterns under the influence of climate change and to discover resistance genes (tools for climate proofing) to better target the Center's rice breeding efforts.

AfricaRice is partnering with US, Canadian and Italian universities, and with French agricultural research

institutions to add nutritional value to low grades of rice, fortify rice-based products and optimize the rice parboiling process. This work deserves special mention because of its focus on combating health-related problems.

The annual report also highlights the Smart-valleys approach used for the development of inland valleys for rice production with national partners in Benin and Togo. This approach has proven its worth in increasing farmers' average yields and is now ready for scaling up to more inland valleys and promotion in many more sites in other countries.

As is customary in all AfricaRice annual reports, there is a spotlight on a donor partner that has contributed generously to funding the activities of the Center.

For 2014, the Bill & Melinda Gates Foundation has been selected for this honor. AfricaRice has a long tradition of partnering with the Gates Foundation, to which it owes a lot of gratitude for the support provided, especially for our breeding work. In fact, the same words of gratitude and appreciation go out to all our partners, ranging from the NARS, farmer organizations, civil society and NGOs to advanced research institutes, sister CGIAR Centers, universities

Chair of the Board of Trustees, Dr Peter Matlon (right), with Interim Director General, Dr Adama Traoré

and private-sector operatives, which have contributed in one way or another to making the Africa Rice Center a veritable center of excellence in rice research and development.

Unfortunately, our research-for-development activities in the second half of the year took place against the backdrop of the Ebola crisis, which concerns all of us, since most of our staff members and R&D partners are based in the sub-region that has become the epicenter of the outbreak. In early August, after a careful consideration of the ongoing uncertainties and health concerns, the Center's management decided to evacuate our internationally and regionally recruited staff members and their families from Liberia and Sierra Leone — two severely affected countries — so that they are not exposed to any risk. AfricaRice does not have any staff based in Guinea. We are praying for the safety of our brave colleagues, who are continuing their work under very difficult and even dangerous situations.

In addition to addressing the immediate priority of Ebola control, international organizations have called for urgent action to re-establish the farming systems in the three Ebola-affected countries. Rice is the most important staple in these countries, and AfricaRice has been actively involved in discussing and planning strategies to make improved rice seeds available to farmers, with strong support from donors as well as the Economic Community of West African States (ECOWAS).

However, despite these difficult circumstances, 2014 has been a challenging, but very productive and successful year, with outstanding results realized within the organization and in partnership. This annual report, with its theme of 'partnerships for impact', is a worthy tribute to a key mechanism or *modus operandi* the Center has relied on since its inception to implement its rice research-for-development activities.

Adama Traoré

Peter Matlon

Partnerships for impact

Partnership is at the heart of AfricaRice with its modus operandi as an association of member states. With increasing challenges on the biophysical, social and resources fronts, the work that AfricaRice does with and through its partners is perhaps more important than ever.

Theory of change

A 'theory of change' is all about how we intend to bring about positive change in the real world.

"A theory of change is needed because it forces one to think about achieving real change, i.e. outcomes and impact from our work," says AfricaRice deputy director general Marco Wopereis. "It means looking proactively (far) beyond our products. How do we ensure these products can indeed make a difference? How do we proactively link with the next users of our products? That requires putting our products out in the real world, and that is happening in our hubs. Products are introduced and tested based on needs identified with our partners, who have also often participated in the various diagnostic and yield-gap surveys that we have conducted in the hubs. It is part of an interactive innovation process. We not only look at what we (research) have on offer, we combine that with 'local innovations', i.e. with what works well locally already, and adapt."

Partnerships are at the heart of the rice sector development hubs, and the hubs are at the heart of AfricaRice's research for development. AfricaRice wants to concentrate its efforts in the hubs because these regions have been chosen by national partners as being strategically important for development of the rice sector. AfricaRice works with partners in the hubs to analyze how to produce quality rice products for the domestic market in sufficient quantities equitably and sustainably.

Multi-stakeholder innovation platforms in rice agri-food systems

From multi-stakeholder platforms…

The film *Sinima Sinima* opens with a scandal: a group of unemployed young men from the village of Doumanaba, Mali, are planting onions in the fertile soil of the community inland valley. This does not go down well with the rest of their community. A meeting is called, but no resolution is found. The mayor is sent on a mission to find a solution. He ends up in Bamadougou village, where AfricaRice and Institut d'économie rurale have helped the community establish a multi-stakeholder platform (MSP) to work together to improve the use of inland-valley resources, while finding mutually agreeable solutions, resolving and minimizing conflicts, and maintaining the integrity of the environment. The film goes on to document the establishment two of the pilot MSPs and some of their achievements.

A major problem for communities that live close to and use inland-valley agro-ecosystems is that there are many groups of people doing their own thing with the local natural resources. Without coordination or even discussion, the stage is set for conflict. In the scenario depicted above, the young men were not supposed to

grow onions in the valley — though it turned out this had a lot more to do with tradition and superstition than agricultural knowledge. And that was not the only conflict. Cattle herders who wanted to graze their cattle were accused of trampling crops; fisherfolk perceived that they were treated as outcasts; small wells for irrigation water were a danger to children who accompanied their mothers into the field… the list goes on and is played out all over the continent. The people of the village of Doumanaba were lucky: the local mayor had heard of another village with issues surrounding the use of its neighboring inland valley, and a delegation from Doumanaba was able to visit Bamadougou and hear their story.

With facilitation from the 'Realizing the agricultural potential of inland valley lowlands in sub-Saharan Africa while maintaining their environmental services' (RAP) project, both communities were able to establish MSPs, where the various users of the inland valley can meet, not only to discuss their differences but also to plan together so that each group gets a fair share of the resources.

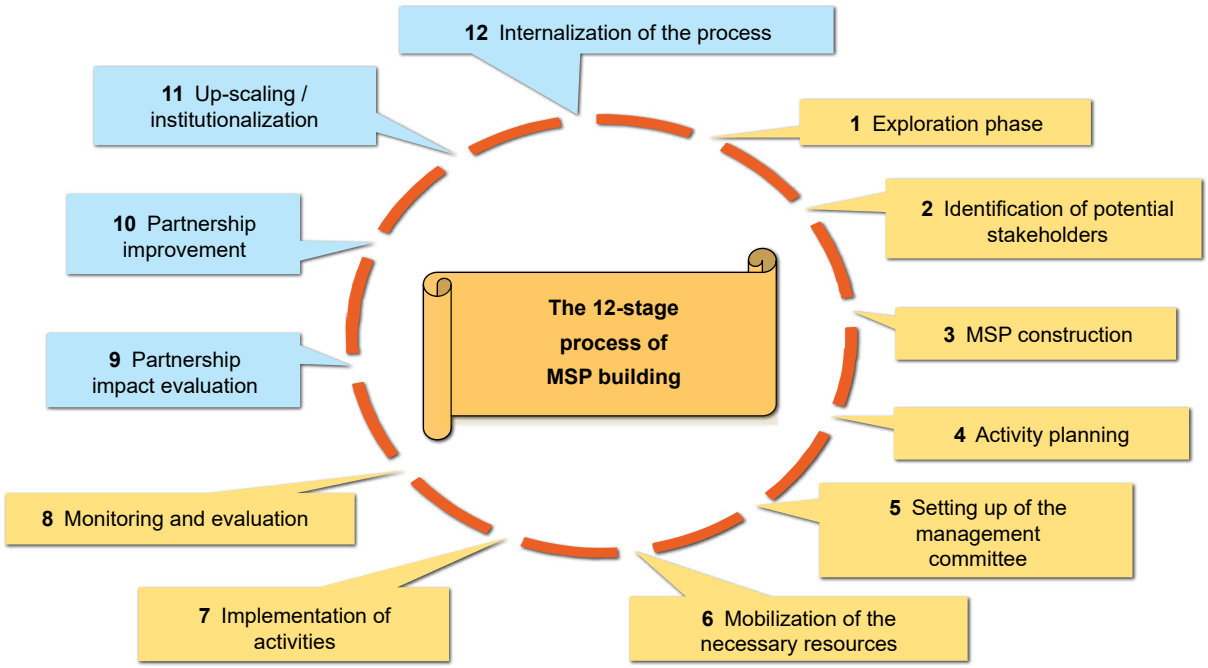
The process starts with a workshop. The village leaders come together with representatives of the various groups of resource-users (farmers of the various crops, herders, fishers, processors, traders) and an external facilitator. These groups are identified at the first meeting, and each group gets to explain how they use the valley and their relationships with the other groups. In a second workshop, each group sets out its vision for the future. This workshop can get quite heated, as each group vies for prominence of its own ideas, and compromises have to be found. Major areas are defined — those activities that the whole community agrees are the most important — the MSP is established and a president appointed. In a third workshop, the MSP develops a plan of activities. Agricultural researchers are also invited to the latter workshops, so that they can see where the communities could benefit from their help.

The MSPs are owned and operated by the communities. They may push the external facilitator or even the researchers to take the lead, but that is not their role. The representatives who sit on the MSP may need training in group facilitation and dynamics, but it is their group, and they have to lead it. If the MSP determines that the community has needs — for example, new varieties of the crops they grow — then they can ask the researchers for help. The researchers themselves may also offer up ideas from their 'baskets of good agricultural practices'.

Four pilot MSPs were established with the aid of RAP in Benin and Mali, two sites in each country. And they were a broad success.

The MSPs involve working together…

…and lots of planning



Value-chain stakeholders' economic benefit from involvement in the MSPs was evident in increased incomes. Innovations and technologies implemented by the MSPs in Benin increased average rice yield by about 0.88 tonnes per hectare, with impact on income of about US$ 100 per year. Group selling of rice increased the price received by producers from FCFA 140/kg to FCFA 160/kg, with average income increasing by over FCFA 50,000 per farm per year, and net profit by about FCFA 94,000/ha. Meanwhile, some rice producers who engaged in (verbal) contractual arrangements increased their net revenues by more than FCFA 70,000 per year. Of those farmers asked, the vast majority (91% in Benin, 80% in Mali) said they had experienced benefits from their involvement in the MSP, including increased productivity via better access to improved seed (both rice and vegetables), technical knowledge (e.g. rice parboiling and other processing techniques, water management, integrated pest management) and market access. About three-quarters of rice producers involved in the MSPs in Benin and Mali increased their lowland rice area as a direct result of participation in the platform.

Farmers learned to take collective action in such areas as bird-scaring, negotiating access to threshing and milling equipment, negotiating paddy price, negotiating land-tenure issues, and even applying for funding from an international donor for a grain store. The forum provided by the MSP was also instrumental in conflict resolution between pastoralists and potato farmers, and between rice and vegetable farmers.

MSP producers of non-parboiled rice in Benin were better off than their non-member counterparts: the domestic resource cost ratio[1] being 0.19 and 0.24 for MSP members and non-members, respectively, in

1. The domestic resource cost ratio measures the ratio of domestic factors used to produce one unit of a product (e.g. labour and capital invested in the production) to the added value generated by this unit of the product (i.e. the value of the production minus all the investment costs, e.g. seed, fertilizer, energy). The lower the ratio, the fewer the domestic resources used to achieve the value added.

Dogbo, and 0.18 and 0.35, respectively, in Houéyogbé. Cost–benefit analysis showed that MSP activities added value along the value chain. For tomato, this was worth $0.1/kg for producers and $0.3/kg for traders, while for Jew's mallow it was $0.41/kg for producers and $0.58/kg for traders.

With the perceived success of the four pilot MSPs, the concept was adopted in rice sector development hubs in Benin (two MSPs), Mali (two MSPs), Liberia and Sierra Leone. Beyond the RAP project, the concept was applied in several countries under the SARD-SC project (*see below*). Moreover, it has been designated the default mode of operation for target communities within all of the rice hubs. To aid widespread adoption of the MSP model, two manuals were produced to guide resource-users through value-chain analysis processes, along with a manual for platform facilitators and the protocol used to establish the pilot MSPs.

"It was clear from the outset of the RAP project that something like an MSP was required — we needed an integrated approach along the whole value chain," says Wopereis. "That is why we got the International Centre for development oriented Research in Agriculture in to help us — they have the expertise."

… to innovation platforms

With the success of the MSPs in the RAP target countries (particularly Benin and Mali), the approach was adopted by the 'Multinational CGIAR support to agricultural research for development on strategic commodities in Africa' (SARD-SC) project funded by the African Development Bank (AfDB).

"Our first issue was the name," explains Sidi Sanyang, coordinator of the rice component of SARD-SC, which was launched in early 2013. "In many development contexts, what we were calling 'multi-stakeholder platforms' in RAP are known as 'innovation platforms'." In fact, a simple Google™ search of 'innovation platform' gives about seven times as many hits as 'multi(-)stakeholder platform'. Another contributory factor was that national agricultural research systems (NARS) were confused by the use of two names for the same thing. "In the end, it was the NARS perception that counted," continues Sanyang, "and for SARD-SC the AfDB prefers 'innovation platforms' (IPs)."

"The IPs are essentially the same as the MSPs in the RAP project, except for the research approach," says Sanyang. The essentially experimental approach of the MSPs in the RAP project was inappropriate for SARD-SC, which was adopting IPs on the basis that the RAP project had proved the efficacy and value of the concept.

"Like the RAP project, SARD-SC is tackling research questions that need a multi-stakeholder approach," says Wopereis.

SARD-SC is taking a business approach to IP establishment: in its target hubs, the IPs have been created to improve the commercial aspect of farming, bringing the whole value chain together to improve 'farming as a business' from choice of crop and land preparation to sale to consumers and food preparers, significantly including both large and small supermarkets.

So, the rice component of SARD-SC initiated IPs in the rice hubs of 11 countries (Benin, Côte d'Ivoire, Ethiopia, Ghana, Madagascar, Niger, Nigeria, Senegal, Sierra Leone, Tanzania and Uganda). Business plans are already in place for seven IPs in six countries (two in Benin and one each in Côte d'Ivoire, Ghana, Madagascar, Sierra Leone and Uganda).

AfricaRice–SARD-SC firmly believes that the IPs should become self-sustaining. The philosophy is that once the rice stakeholders see the value of the IP they will want to maintain it, even if for another (albeit similar) purpose. "Sustainability of an IP does not necessarily mean keeping the same form and purpose, but rather that the IP actors have the innovative capacity to take advantage of emerging opportunities as well as constraints in improving their livelihoods," says Sanyang. "So a successful and sustainable IP is

dynamic and not static." According to Sanyang, IP sustainability is dependent on getting its three drivers 'right' — the technologies, the organizational aspects (how the IP is established and facilitated) and the institutional side (working with the culture, norms and value systems of local and national institutions and policies for the benefit of the IP actors).

These IPs are already apparently improving the productivity and turnover of stakeholders throughout the rice value chain, less than 2 years into the rice component of the project. The example of the two IPs of the Glazoué hub in Benin is given in Table 1.

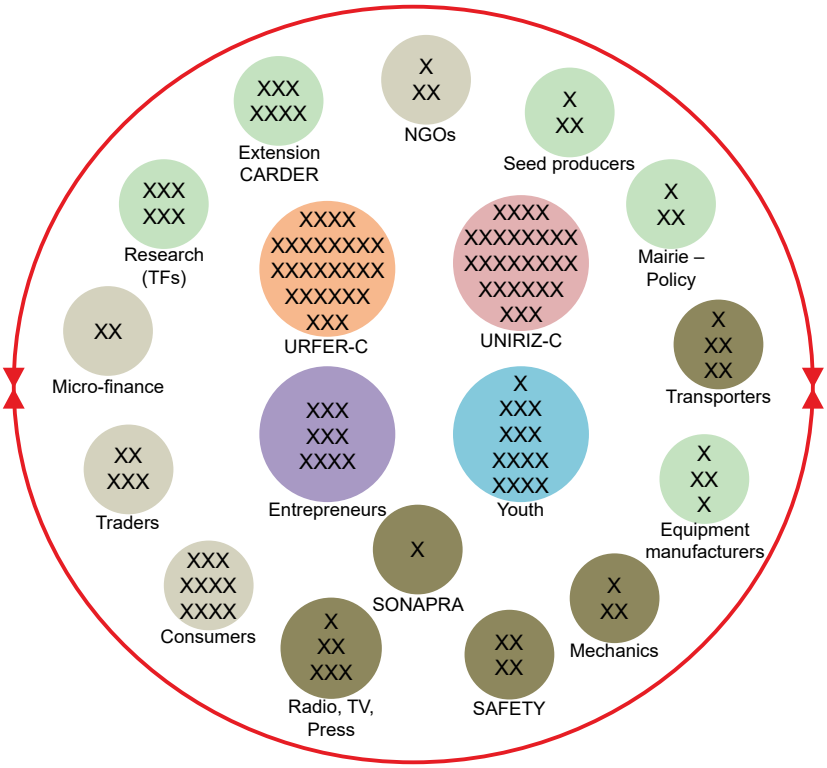
There, because the quality of rice processed by IP members has improved, the consumer price of long-grain rice has increased from FCFA 600/kg to FCFA 700/kg. Moreover, this price increase has not negatively affected consumer behavior; rather, consumers have encouraged traders to continue to improve the quality of locally produced rice for household food security.

The creation of IPs in the Glazoué rice hub encouraged farmers and entrepreneurs to take on rice as an additional source of income. The establishment of the Bante and Glazoué IPs led to a significant local policy shift to support the rice value chain: (i) the *mairie* in Glazoué linked (old and new) projects with the IPs and allocated a market stall to the IP's rice-processing (parboiling) group for them to sell their produce locally; (ii) the *mairie* promoted the sale and consumption of locally parboiled rice through contractual arrangements with women parboilers; (iii) the *mairie* in Bante allocated land to the Entreprises de services et organisations de producteurs (ESOP) rice-processors' group in the IP to construct a processing unit; and (iv) the advocacy group within the *mairie* in Bante has been canvassing additional support for ESOP and other rice value-chain actors in the IP.

However, it is far too early to call this 'impact'. Sanyang explains: "What we have is isolated signs

Table 1. Changes brought about by innovation platforms (IPs) in the rice value chain

Stakeholders	Before IP	With IP
Farmers/producers	3.5 t/ha	5.0 t/ha
Women parboilers (Bante IP)	1.0 t paddy/month (during harvest)	10 t paddy/month (during harvest)
ESOP processor (Bante IP)	1.5 t paddy/day (during harvest)	5 t paddy/day (during harvest)
Processors (SONAPRA millers)	500 t paddy (during harvest)	1000 t paddy (during harvest)
Traders	Sold 15 t/month	Sold 20–25 t/month
Mini rizerie (Glazoué IP)	25% increased income	50% increased income
Extension (CARDER)	Reached 100 rice farmers	Reached 250 rice farmers
NGO (MRJC)	Reached 4 villages	Reached 9 villages
Microfinance (CLCAM)	FCFA 10 million	FCFA 21 million
Policy (local government)	Cotton + maize as cash crop	Cotton + maize + rice as cash crop



Actors of the innovation platform in the Glazoué rice sector development hub

This is a visualization of a functional IP in value chains, food systems and natural resource management. It shows the various stakeholder groups. The number of Xs shows the relative size of the groups of actors involved in the IP. As usual, producers (UNIRIZ-C) and processors (URFER-C) are the largest groups. (SONAPRA: state agricultural development company; SAFETY: skills on safety in rice parboiling plant.)

of change. We haven't conducted a formal impact assessment yet. Indeed, 2 years into the project is far too early to do that. Impact assessors don't like us to talk about 'impact' when what we have is little more than anecdotal evidence. We can see triggers of change, and small positive changes in the right direction. In impact-assessment speak, we are on track with the 'impact pathways'."

The bigger picture

"The IPs are the engines of the hubs," says Wopereis. "Without the IPs there is no innovation. They are essential. Here is where we conduct 'real-time' research for development. This is where we create 'outcomes' — where our products are put to the test, combined with other local ideas and interventions, and where we create positive change. We cannot work everywhere that intensively, so it is important that stories from the hubs get out and inspire others. We must also link proactively with 'scaling partners' that are interested in our work and perhaps pick a particular element and run with it. These are the ways of creating more outcomes and eventually impact." 'Scaling partners' are development partners from the public and private sectors that AfricaRice connects with *outside* its project portfolio — they use their own resources, approaches and monitoring and evaluation (M&E) to scale out technologies that stem from AfricaRice collaborative research-for-development work, conducted with value-chain actors, research partners and (these and other) development partners.

Through the IPs, 'issues' and opportunities are identified. The multi-stakeholder approach enables IPs to work at every level in the rice value chain — organizational and institutional issues (e.g. contractual arrangements, quality control rules and regulations),

technological and biophysical issues (e.g. what variety is best suited to the local environment? how can we make parboiling more efficient?) and issues related to collective action, learning and knowledge-sharing.

Meanwhile, through the Global Rice Science Partnership (GRiSP), AfricaRice is also working at other levels to try to maximize the potential of the technologies (including development approaches) coming out of the hubs. GRiSP conducts policy research and advocacy to provide a suitable political environment for the rice sector to flourish. It also provides capacity-strengthening for partners to facilitate scaling up and achieving impact.

The IPs set an example of how diverse stakeholders can work together to achieve positive change, and the fact that individual communities benefit from being part of a hub and having an IP is indisputable. But the IPs and hubs are really only the testing and proving beds for technologies. AfricaRice simply does not have the resources to make all the good outputs from the hubs available to rice value-chain actors across the continent. That is where the 'scaling partners' come in. AfricaRice therefore documents all of the 'scalable technologies' (products and services) and makes them available via the Rice *e*Hub (www.ricehub.org) in various formats, including video. It also brings scaling partners together at innovation fairs to showcase the latest technologies. These scalable technologies are thus available for scaling partners to pick up, test, adapt and disseminate as they see fit, and with their own resources.

"Scaling partners from the private and public sectors may run with 'our' scalable technologies," says Wopereis. "What we want to achieve is that they report back on performance of technologies and on (gender-disaggregated) uptake." In that way, AfricaRice will be able to draw on its own M&E in the IPs and hubs, and profit from information coming out of the scaling partners' M&E to see more clearly how all these joint efforts are contributing to the intermediate development outcomes of the GRiSP 'Results Framework', which in turn feed into the CGIAR System-level Outcomes and the global Sustainable Development Goals.

Nigeria Rice Transformation Agenda

Nigeria is one of the biggest countries in Africa; it is also the most populous and produces more rice than any other country on the continent (and roughly on a par with Madagascar). It is therefore hardly surprising that AfricaRice and Nigeria have a special relationship. In the past few years, AfricaRice has provided input into the rice component of Nigeria's Agricultural Transformation Agenda (*see also* 'Case study: Nigerian Rice Transformation Agenda', *AfricaRice Annual Report 2013*, pages 14–15).

Taken as a whole, the Rice Transformation Agenda (RTA) was a complex set of partnerships, primarily initiated by the federal government to boost the Nigerian rice sector through to self-sufficiency.

AfricaRice's involvement was diverse: secondment of three senior staff to the Rice Value Chain (unit) of the Federal Ministry of Agriculture and Rural Development (FMARD); seed supply and seed systems development; and rice-sector mechanization. Its roles include provision of professional personnel (their time, knowledge and skills), seed, thresher–cleaner, training and other capacity-development inputs. The AfricaRice partnerships span from the federal ministry to farmers (especially if one includes the Nigerian rice sector development hubs where AfricaRice-led task forces are active on the ground). The novel partnerships, however, are those with the private sector.

Giving our best technologies for adoption in Nigeria

Contrary to what any commercial organization might do, AfricaRice is not averse to handing over its technologies to the private sector for scaling up to

a far greater client base than AfricaRice could ever hope to reach on its own. How else are we going to help countries such as Nigeria achieve their goal of rice self-sufficiency? In the context of the RTA, the two technologies in question are the thresher–cleaner and seed of improved rice varieties.

Mechanization

In 2013, AfricaRice took one of the 'ASI' thresher–cleaners from Senegal to Nigeria, along with its 'father', Malick Ndiaye. A 2-week intensive training workshop ensued at the National Centre for Agricultural Mechanization (NCAM) for 24 young engineers from 13 Nigerian manufacturing companies. These engineers built the first thresher–cleaners in Nigeria, which were branded ATATC for 'Agricultural Transformation Agenda Thresher–Cleaner'. One of the NCAM engineers was tasked with producing engineering drawings and specifications of the prototypes for subsequent evaluation and distribution. At the training workshop itself, five ATATCs were built, and subsequently 10 ATATCs were distributed to the main dry-season rice-growing states of the country to raise awareness of their existence and the value of using them.

After the training workshop, the attendees were given (yes, given!) copies of the technical drawings and specifications to take back to their companies for fabrication of a fleet of ATATCs to meet the growing demand (*see also* Box: 'Not just the private sector: Major adoption of the ATATC by the public sector in Nigeria'). Subsequently, six companies in six states started producing their own versions of the ATATC. Typical adaptations to the NCAM prototype have been to make the thresher–cleaner smaller and to add various components.

The ATATC manufacturers have won contracts from government, individuals and commercial farms.

Seed

Another major element of the RTA was seed systems development. AfricaRice's 'normal' responsibility to its member states is to provide Breeder Seed of the required rice varieties, which the public sector (commercial seed producers) and private seed companies then multiply to Foundation Seed and from Foundation to Certified Seed, which is 'sold' to farmers. However, the public sector in Nigeria does not have the capacity to produce enough Foundation Seed, so AfricaRice has stepped into the gap by providing Foundation Seed both to the public sector and direct to the commercial seed producers. It is actually quite unusual for rice farmers to use Certified Seed, as they more often rely on the self-fertilizing nature of rice and save some of their grain to use as seed the following season. However, Certified Seed is generally of better quality than self-saved seed, so the government opted to subsidize it through a national Growth Enhancement Support (GES) program. Under

Not just the private sector: Major adoption of the ATATC by the public sector in Nigeria

The Rice Value Chain organized demonstrations and market exposure of the ATATC in rice-farming communities across the 10 key rice-producing states in September–October 2014. As a result of the machine's success, the Federal Department of Agriculture (of FMARD) is no longer buying other sorts of threshers, and is to procure 200 ATATCs from local (private-sector) fabricators.

The ATATC has also been approved as cleaning equipment by the country's paddy-aggregation centers. The ATATC technology was adopted by the International Fund for Agricultural Development (IFAD) for a television documentary to create awareness.

The Minister of Agriculture showed a video on the ATATC to the governor of the Central Bank of Nigeria, who consequently promised to support promotion of the machines.

Capacity-building in good agricultural practices (GAP) for extension workers and lead farmers, Niger state, Nigeria

GES, the government was to subsidize (by 50%) two bags of fertilizer and one bag of seed per hectare. But farmers refused to pay for seed, and the government ended up subsidizing it by 100% for the first 2 years, only dropping to 75% in the third year.

With the massive increase in demand for seed under GES, seed merchants and companies with outgrower schemes have proliferated. Unfortunately, many of these are inexperienced in modern techniques for quality seed production, and so the seed produced has been of inferior quality and not fully reliable. Consequently, as part of the drive to increase the production of quality seed, AfricaRice conducted a training course on seed production for two communities in Ekiti State in May 2014. The two 1-day events were attended by 44 outgrowers (12 of them women), 2 extension agents and 1 certification officer from the state Agricultural Development Project. The 34 outgrowers (9 women) in Ikoro were already cultivating lowland cultivars NERICA-L 19, SIPI and WITA 4, while only 5 of the participants in Aisegba were currently producing seed (of upland cultivars).

The training covered all aspects of seed production, from the basics of the importance of seed, knowing the rice plant, different growth stages of rice, morphological characteristics of different cultivars, to site selection, isolation requirement, land preparation, seed rate calculation, crop establishment, nutrient management, weed and water control, rouging (removal of 'off-types' that do not conform to the cultivar's characteristics), harvesting, threshing, drying, seed selection and storage; it also covered sound business practice to enable participants to develop seed enterprises and seed business plans. Similar training is expected to be delivered in the future, including seed production for 30 technical staff from 10 commercial seed companies and recognition of cultivars and seed quality control for 50 National Agricultural Seed Council seed inspectors, both in the first half of 2016 and funded by the Feed the Future initiative of the United States Agency for International Development (USAID).

Encouraging millers to process local rice

Like many other parts of (particularly West) Africa, local rice in Nigeria suffers from an image problem. It is viewed as smelly (having an unpleasant odor), non-uniform and full of impurities (e.g. stones, weed seeds). Moreover, the commonly used 'cottage mill' does not produce quality grain from local rice. Consequently, the bigger milling companies in Nigeria prefer to import brown Asian rice and mill that for onward sale to the market. This is clearly a problem when the government is targeting self-sufficiency.

An example of the way forward has been set by the establishment of the country's biggest mill in Nasarawa State. In 2014, the largest 'integrated rice mill' facility in Nigeria was established by Olam International Ltd/Olam Nigeria. The Olam mill is set in a vast 6000-ha estate, of which half is so far under mechanized irrigated rice production. Olam's Managing Director for Africa and Middle East, Venkataramani Srivathsan, indicated that the company aims to expand to over 10,000 ha in Nasarawa State. The company has its own outgrower and contract farming scheme, and will ultimately source rice from 20,000 smallholders to fill 30–40% of the new mill's capacity. This will be a major contribution to increasing domestic rice production, and all on the back of AfricaRice-provided seed!

At the commissioning ceremony, then Nigerian President Goodluck Ebele Jonathan noted the rapid growth in the number of private-sector rice mills from 1 to 18 in just 3 years.

The Nigerian Minister of State for Agriculture, Akinwumi Adesina, indicated that integrated mills were the way forward for rice in Nigeria. AfricaRice — ever a champion of rice smallholders — indicates that the way forward will be to support the cottage mill. If smaller-scale processors can acquire destoners and polishers, cottage mills themselves will become integrated and produce white rice that is competitive with that from the large integrated mills.

The Nigeria government's new strategic grain reserve facilities in Kwali, a suburb of Abuja, built in 2014 — an important part of the RTA

Knowledge management and linkages with rice sector development hubs

With increasing demand for AfricaRice to scale out its technologies, especially within and beyond its rice sector development hubs, it needs comprehensive knowledge management support to respond to the various categories and resources of users. "We needed a comprehensive system in place that can facilitate interaction and feedback between the farming communities and science communities. We wanted to create the space and tools to facilitate learning at every stage of technology dissemination and adoption," says AfricaRice head of knowledge management and capacity-strengthening Myra Wopereis-Pura. Therefore, in 2013, AfricaRice began to test and put in place a system that would allow face-to-face interaction (innovation fairs), virtual access (Rice *e*Hub) and user-adopted tools (rice radio programs and farmer-to-farmer video) to disseminate and communicate the potential and use of its scalable technologies.

Rice *e*Hub

The Rice *e*Hub was designed for NARS partners in the hubs to document successful 'scalable' technologies and information on other technologies from other NARS and scientists.

"The concept behind the Rice *e*Hub is to bridge science and practitioners," says Wopereis-Pura. "We wanted to provide our national partners with an online space to document technologies that were proven useful and

are in use. Such technologies are tested and adapted in at least one hub before we allow them to be uploaded on the *e*Hub."

This required collaboration, not just with NARS research, extension and farming communities but also among AfricaRice scientists, especially the various task forces. Scalable technologies were documented using a technology description narrative, which contained information about each technology's use and target users, as well as its advantages and disadvantages. But, most importantly, it also provided information on the support services required for the successful adaption and adoption of the technologies.

To gain time and resources, AfricaRice decided to adapt the most relevant information system in Africa, which is the online learning platform of the Regional Agricultural Information and Learning System (eRAILS) developed by the Forum for Agricultural Research in Africa (FARA) as "the African portal on agriculture." The Rice *e*Hub started with the same architecture as eRAILS, but with more practical features for rice research and development communities.

Knowing that content management will be critical for the Rice *e*Hub, AfricaRice trained designated 'information and knowledge exchange facilitators' (IKEFs) — NARS staff identified to support communication and knowledge management in the rice hubs — in how to use the website and collaborate with colleagues in rice research and development in each of their countries. Small amounts of funding were provided to cover their time and effort in uploading their own material.

In Mali, the IKEF is Mohamed Dicko, a researcher at Institut d'économie rurale (IER), rice sector development hub coordinator for the country and the only IKEF who is not a communications specialist. He says, "The training we received allowed us to create country pages on the Rice *e*Hub platform, and sites for each hub, Kouroumari and Sikasso. On these pages we uploaded information on rice and the activities of researchers."

Dicko uses the Rice *e*Hub to keep informed about what is happening in the hubs of other countries to guide his own research. As IKEF, the *e*Hub enables him "to be in touch with researchers and contribute to their activities" by providing information they require.

Irène Razafindraibe, communication unit manager at Centre National de Recherche Appliquée au Développement Rural (FOFIFA) and IKEF, comments on the experience with the Rice *e*Hub in Madagascar: "This virtual portal is a broadcast channel for information on rice in Madagascar. It is set up with the aim to create exchanges between development actors to boost rice production on the 'Big Island'."

Though the general reception is positive, Dicko does highlight two difficulties with the system. First, "the availability of information from researchers" — the *e*Hub is primarily used by communications staff in the NARS — so researchers need to be informed of the benefits of using the *e*Hub to make their work more visible. Second, "the quality of connections that slows down the use of the internet, specifically the Rice *e*Hub."

IKEF training, Cotonou, Benin, June 2014

In October 2013, the Third Africa Rice Congress made a recommendation that AfricaRice and its partners "facilitate knowledge exchange to achieve greater and more rapid impact across the rice value chain." Launched at the 2013 Congress, the Rice *e*Hub continues to deliver on this demand from high-level African rice stakeholders.

Seeing the usefulness and potential of the Rice *e*Hub, AfricaRice was able, in 2014, to launch a new project with support from Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) to enable technologies to be scaled out and for their spread to be documented — 'Catalyser l'adoption et l'utilisation des technologies évolutives en Afrique' (CAUSA). Specifically, the project aims "to strengthen the innovation process and in particular to increase the adoption-rate of improved technologies by systematic information exchange and interaction between value-chain actors and the research and development community."

Meanwhile, the 'tried and tested' scalable technologies have also been written up as one-sheet briefs for a folder on *Rice Scalable Technologies* for distribution at appropriate events, such as training courses and visits to AfricaRice stations.

Rural farm radio

Within the context of the RAP project in Mali, AfricaRice teamed up with Farm Radio International to train local radio broadcasters in the project target regions in participatory program development. At its most basic level, the broadcasters were taught how to listen to and understand the farming programs that they broadcast, and to facilitate listener participation.

In collaboration with the actors in the MSPs, Radio ORTM of Sikasso developed four radio programs. As did Radio Kafokan of Bougouni (*see* Box 'Radio programs developed by local radio broadcasters and NARS partners in the RAP project'). Radio ORTM recorded 463 votes to survey questions through a beep-to-vote system and 215 calls to the studio, while Radio Kafokan recorded 2161 votes to survey questions and 259 calls to the studio. These two radio stations in the Sikasso region now have the capacity to develop their own programs, having adopted the Farm Radio International's VOICE (value, opportunity, information, consistent/convenient, entertaining) standards for their own programming.

Radio programs developed by local radio broadcasters and NARS partners in the RAP project

The Radio ORTM, Sikasso, Mali:

- Rice postharvest handling practice and technologies
- Promotion of the MSPs
- Potato and sweet potato production, harvesting and postharvest techniques
- Lowland rice parboiling and marketing.

Radio Kafokan, Bougouni, Mali:

- The learning experience in the framework of the learning trip to Bamadougou
- Constraints related to off-season commodity production, including the benefits of producing potato
- Needs and opportunities for setting up MSPs to improve resource management in inland-valley lowlands
- The benefit of using quality seed of improved rice varieties.

Faculty of Agricultural Sciences of the University of Abomey-Calavi and Institut national de recherches agricoles du Bénin, Benin:

- Hydrological and economic modeling of the Couffo River catchment for participatory assessment of agricultural intensification
- Resistant tomato varieties for the fight against bacterial wilt in inland valleys
- Improving inland-valley biodiversity by introducing multi-purpose vegetables.

Meanwhile, agricultural research topics for radio program production were identified by the Faculty of Agricultural Sciences of the University of Abomey-Calavi (FSA-UAC) and the Institut national de recherches agricoles du Bénin (INRAB) (*see* Box, previous page). These topics were covered in a 60-minute program broadcast by Radio Voix de Lokossa (which covers Couffo and Mono departments, Benin). The program was broadcast four times with facilitation and translation in three local languages (Adja, Fon and Mina) by Voix de Lokossa and La Voix du Couffo (another major radio station in Adja-Homnè, Couffo department).

"In Madagascar, radio remains the appropriate tool for communication in rural areas, since it allows everyone, including the illiterate, to express themselves," says Razafindraibe. "Also, because of its convenience, it is the tool most accessible to farmers and is certainly within their reach." The 'IKEF program' in Madagascar produces programs on topics identified by the task forces in consultation with rice value-chain actors in the hubs. Razafindraibe states that these programs are broadcast on local and national radio "to sensitize the rural population to new technologies made by research."

Innovation fairs

To promote face-to-face knowledge exchange, AfricaRice organized the First Innovation Fair on Scalable Rice Technologies for Benin and Togo at its temporary headquarters in Cotonou in September 2014. NGOs and farmer organizations were invited to this showcasing of scalable technologies, which enabled them to learn about the technologies through posters (and the technologies themselves in the case of machinery) and then discuss them in detail with the researchers involved in their development and dissemination. (*See also* 'Scalable rice technologies', page 58.)

Farmer-to-farmer video

Video is increasingly being used by various research-for-development organizations around the world to enable farming communities to share their experiences with other communities — farmers are more likely to try a new technology if they see another farmer enthusing about it than if it is simply being promoted by a researcher or extension agent. AfricaRice developed its own series of farmer-to-farmer videos in the form of its *Rice Advice* collection on DVD (*see* ''Rice Advice' farmer-to-farmer videos', page 37).

AfricaRice then worked closely with video-maker Digital Green to supply film-making equipment to NARS and train NARS staff in the hubs on film production.

Jacob Dunyo, agriculture officer at the Ministry of Food and Agriculture and IKEF for the Kumasi rice hub in Ghana, was trained "on farmer-to-farmer and extension video production … by [a] trainer from Digital Green." The trainees included farmers and agricultural extension agents. "We were trained in how to write a storyboard before the filming, and [that] this should be approved by a technical team," says Dunyo.

According to Dunyo, his post-training remit is to develop videos for "all the activities in rice production

from land preparation to marketing. We have the cropping calendar which we follow."

The Ghana videos are being produced in the local languages of Ewe and Twi.

Unfortunately, Dunyo and his team experienced technical problems — the camera's microphone picked up too much of the surrounding sound, so their first two films had poor sound quality.

Understanding these challenges, the IKEF of Ghana from the Crops Research Institute (CRI) is providing support to get the video improved and multiplied for use in the Volta Region. The extension agency in the region appreciates the initiative as a support to its limited extension capacity (one extension agent has to cover 500–1000 farmers). A locally produced video could be given to farmer leaders to discuss technologies useful for the farmers in their communities.

Strategic knowledge management support services are critical for the success of scaling up technologies. It requires intensive interaction among research, extension and farming communities. Partnership within the countries and at the global level will facilitate learning on how to design the most appropriate tools for the farming communities, as well as how to strengthen researchers' understanding of the value of communication in the development, use and dissemination of technologies.

"AfricaRice is all about producing international public goods," says AfricaRice deputy director general Marco Wopereis. Historically, CGIAR and its component centers have seen the philosophy of international public goods as being incompatible with involving the private sector, but that has had to change. "AfricaRice is a research and development organization, but there are limits to how much development we can do," says Wopereis.

Since AfricaRice is still an association of African states, it is bigger than just its core staff. "We have to devolve responsibility for wide-scale adaptation and distribution of technologies to the national level," says Wopereis. "And the only way to do that at any scale is to involve the private sector." Since the private sector is interested in profit, it is therefore prudent for AfricaRice to hand over its products and 'lose control' over them if it wants to make wide-scale impact.

Conservation agriculture in the fight against *Striga* in Madagascar

As we travel the 87 kilometers west-north-west from Antsirabe to Ivory we pass through valley after valley, each jam-packed with rice fields, most of them full of water in January in the wet season. However, once we reach Ivory, we are in the midst of rainfed upland rice and maize fields. This is the heart of a rice sector development hub, but what exactly is AfricaRice doing working on upland rice in a country where every tiny space in the inland valleys seems to be terraced and used for rice production?

Extensive terraced paddies fill the inland valleys of Madagascar — yet still the country is not self-sufficient in rice

Despite the abundance of rice paddy fields throughout the country, Madagascar is not self-sufficient in rice. The country has one of the highest rice consumption rates in the world: at 138 kg per person per year in 2010, it is exceeded only by The Gambia in the African context. While Madagascar produced 4.7 million tonnes (Mt) of paddy in 2010, it still imported 132,000 tonnes of milled rice. With total rice consumption of 3.4 Mt (milled rice), the overall self-sufficiency ratio in 2010 was 96% (data from *Africa Rice Trends 2001–2010*). Moreover, because the inland-valley paddy production is not with full water control, there is massive year-on-year variation in production — for example, in 2013 national paddy production was just 3.6 Mt, some 23% less than in 2010.

With the inland valleys already fully exploited, farmers are moving uphill and growing rice in rotation with maize in areas with free-draining upland soils.

Rice production faces many constraints in Madagascar. Among the most important in the rainfed upland areas are white grubs (beetle larvae), crickets, low soil fertility, soil erosion and the parasitic weed *Striga asiatica* (sometimes called 'witchweed').

Along with its partners — Centre national pour le développement rural (FOFIFA, the Madagascan national program) and Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) — AfricaRice is working at Ivory (pronounced 'ee-vur'), and other locations along highway RN34 between Antsirabe and Ivory, on rice–maize cropping systems, with a particular focus on reducing the impact of *Striga*.

"We are truly privileged here at Ivory, because we have a large experimental farm in which we have established plots that are much larger than those normally used in agronomy trials," explains AfricaRice Agronomist Jonne Rodenburg. The area available enables the researchers to harvest plots of 40 square meters even after allowing for border areas.

"Given that some farmers are abandoning fields because of high *Striga* pressure, plus soil erosion, moisture-retention and fertility issues, we decided to look at zero-tillage 'conservation agriculture' rice–maize rotation systems incorporating legume species that should fix nitrogen in the soil," explains Rodenburg. These systems have been established in comparison with the farmers' traditional practice of simple rice–maize rotation in which they remove all of the crop residues each season after harvest and plow the fields before each crop.

The primary experiments cover three new systems based on conservation agriculture principles: one with cowpea and mucuna; one with rice bean; and one with *Stylosanthus guianensis* (a perennial legume referred to simply as 'Stylo'). In the first year, the researchers sow rice, just as the farmers do. However, in the Stylo system, Stylo is sown along with the rice in the first year.

At the end of the first season, the rice is harvested, but unlike the farmers' practice the straw is left on the field so that the second-season crops (maize, cowpea and mucuna; maize and rice bean; or just maize in the Stylo system) are sown among the rice residues. At the end of the second season, the crops are harvested (maize grains and beans/peas), and again the residues are left on the field. Thus, in the third season, rice is sown among the maize and legume residues. The 'odd one out' of the legume crops is the Stylo, because it is not a food crop. Moreover, it forms a dense matting across the whole field. While it is managed in the first rice season, it is allowed to grow around the maize in the second season. For the third-season rice crop, however,

Rice growing in Stylo and maize residue (year 3 of the rotation)

Maize and legume intercrop growing in rice residue mulch (years 2 and 4 of the rotation)

Maize with growing perennial Stylo in rice residue (years 2 and 4 of the rotation)

Stylo would easily outcompete the rice seedlings, so it is cut prior to rice sowing and left as a dense mat of dry vegetation across the field, with re-sprouting shoots and new seedlings derived from the seeds shed in the second season.

"The crop residues form a mulch in the field," explains Rodenburg. "This has several positive effects. First, the ground cover suppresses weeds. Second, it acts as a moisture-retention layer, which is valuable in an area noted for its variable rainfall pattern. Third, the mulch layer serves to protect against a certain amount of soil erosion." Few, if any, fields in the Madagascan highlands are really flat, so torrential tropical rains tend simply to wash the topsoil downhill. Crop residues help retain topsoil on the slopes. "And, of course, there are the hoped-for effects on *Striga*, such as suppression by mulch and effects of changes in soil moisture and temperature, and perhaps allelopathic effects from the crop residues," concludes Rodenburg.

On average, across years and rice varieties (*see* page 23), the system including Stylo has had by far the fewest emerging *Striga* plants. "There are several mechanisms by which *Striga* may be controlled in these conservation agriculture systems," explains Rodenburg. "First, the lack of tillage [plowing] means no mixing of the *Striga* seeds within the upper layers of soil so that few of the new seeds enter the soil seed bank. Second, the legumes fix nitrogen, and high soil nitrogen is known to inhibit *Striga*. And third, we have biochemical control systems exerted by the legumes."

Alain Paul Andrianaivo, FOFIFA researcher on the project, explains: "We know that some legume species like soybean, cowpea and peanut cause suicidal germination of *Striga* seeds in the soil. This principal could guide us to design useful rotation or intercrop systems for farmers dealing with *Striga*."

'Suicidal germination' means that soil-borne chemicals from the legume plants cause the *Striga* seeds to germinate in the absence of a suitable host so that they survive as seedlings for only a few days. A second potential biochemical control mechanism is suppression of *Striga* germination by the legume.

To test the germination stimulation or inhibition hypotheses in the field, the team looked not only at the numbers of *Striga* plants emerging and crop yield, but also at the *Striga* seed bank in the soil. This should help them determine whether the *Striga* seed bank is being depleted through suicidal germination, or whether the seed bank is maintained through germination suppression. They will also test these hypotheses in the laboratory.

While the Stylo system works best overall in terms of crop yields and *Striga* control, Rodenburg has some concerns. "Of the four systems — including the control or farmers' current practice — the Stylo is by far the most complicated and difficult to manage," he says. "We learned that it is essential to cut the Stylo before sowing rice in the third year of the rotation, and that in itself is a big job."

Rice varieties and their effects

Having such large plots, the research team was in a position to further divide the experiments to look at additional factors. One of these factors is rice variety. Traditionally, farmers have grown a *Striga*-susceptible local variety known as B22, but AfricaRice's NERICA 4 has become popular in recent years and is highly *Striga* resistant. Consequently, the main experimental plots were divided into three to compare the effects of three varieties: B22, NERICA 4 and moderately *Striga*-resistant and newly introduced NERICA 9.

Across cropping systems, NERICA 4 is consistently producing the best results.

"It is important that we develop integrated systems," says Rodenburg, "so that different components can cause a synergetic effect, and that varietal resistance breakdown is slowed down because of the fact that even fewer *Striga* plants produce seed when a resistant rice variety is accompanied by other *Striga*-control technologies." Reliance on a single feature (e.g. crop resistance) to deal with a problem such as *Striga* is extremely risky, as anything that should negate the effect of the feature relied upon could lead to catastrophic crop loss. "Thus, it is important that we use the best available variety within our cropping systems of choice," says Rodenburg.

With the variety trials there was one completely unexpected result: a carry-over of *Striga* reduction to the following maize and legume crop in the fields that were previously planted with the resistant rice varieties. "This is not something we have come across before or expected," explains CIRAD Agronomist Patrice Autfray, who is based in Antsirabe and works on the project. "We need to determine the mechanism for this carry-over of *Striga* suppression."

The soil fertility problem

Madagascar's soils are known to be poor in nutrients. This was, after all, one of the reasons for introducing legume crops into the rotation system — legumes fix atmospheric nitrogen, making it available to adjacent and following crops.

Randomized plot and split-plot trials; note in particular the plot top left in which the left half has received phosphate fertilizer and is consequently darker green (healthier) than the right half without fertlizer

AfricaRice's Jonne Rodenburg (left) and CIRAD's Patrice Autfrey discussing the project trials in the field

The soils around Ivory are notoriously poor in phosphorus, which manifests itself in terms of reduced maize growth. Consequently, the team has established a number of sub-plots, in which they are testing the effects of applying phosphate fertilizer to the maize crop. So far those plots to which phosphate has been added seem to be producing stronger and faster-growing maize plants.

Keeping an open mind: Testing other potential systems

Autfray is keen to keep an open mind about what might work best for the highland rice and maize farmers of Ivory. "We have set up 'gardens' for participatory varietal selection of rice varieties and legume species," he says.

Spreading the word through farmer videos

There was a time when the written word was the principal means of communicating scientific research findings. In terms of scientist-to-scientist communication, this is almost certainly still true today. But research for development cannot stop at the point of publication in a peer-reviewed journal. AfricaRice research is intended to benefit rice farmers and other rice value-chain actors through to consumers.

For some years now, AfricaRice has been using video to raise awareness about new technologies across broad target audiences. Research has shown that using the medium of video about new technologies or techniques is effective in engendering enthusiasm among the peers of those who 'star' in the videos (*see*, for example, 'Profiles of selected PhD candidates — Espérance Zossou', *AfricaRice Annual Report* 2012, page 54).

Indeed, AfricaRice specifically chose video as one of the mechanisms for reaching value-chain actors not directly involved in the research conducted in the rice sector development hubs, alongside capacity-building and exchange visits, in the implementation of its strategy for 2011–2020.

The video-makers in action filming interviews with local farmers M. Andrianasolo Jean Henri (top) and Mme Mariette

His vision does not stop there, however. “We are also looking at other crops and combinations that might benefit the primary crops,” he says. “For example, we established some plots in which we intercropped rice with peanut. Peanut is an alternative host for a butterfly caterpillar in the genus *Junonia*, which also attacks *Striga*. Perhaps by attracting the butterfly into the field with the peanut, the caterpillars will eat the *Striga*.”

This kind of ‘blue sky’ thinking is key to making innovative strides in helping the farmers. It helps assess the best knowledge and stimulate the best thinking on conservation agriculture to increase food production, reduce food insecurity, and enhance sustainability. However, in January it looked like the peanut experiment was unlikely to succeed, as most of the rice intercropped with peanut was showing signs of nitrogen deficiency.

Beauty in the field: experimental rice and peanut intercrop

Jonne Rodenburg is a keen proponent of video, making extensive use of the medium in his weed-management work across the continent. For the 2014/15 season, the Ivory project team has employed video-makers Mada-Movie under the direction of Stéphane Corduant to develop a new video on the practice of conservation agriculture and its positive effects on *Striga* control.

Consequently, the full team of Rodenburg, Patrice Autfray and Alain Paul Andrianaivo has been visiting the Ivory field trials at critical points during the rice season along with the video team for a couple of days at a time. The goal has been to capture the critical growth stages of the rice, maize and legume crops, as well as interviews with interested, innovative and early adopting farmers dealing with *Striga* problems.

A new innovation for this particular video is the use of a radio-controlled helicopter (known as a ‘drone’), with a high-definition camera attached, to take aerial video and photographs.

The cropping season will end in May or June 2015, and it is hoped that the finished video will be available for use in promoting conservation agriculture before the next season starts in November.

Film director Stéphane Corduant (left) and cameraman Antso Andrianary controlling the drone

Climate-proofing East Africa's rice sector

For rice as for other crops, the distribution and behavior of diseases is expected to change under the influence of climate change. In fact, it is already doing so. In rice-disease hot spots in Tanzania, 92% of rice farmers with 15–30 years experience have observed increased temperatures and changing rainfall patterns in terms of timing and amounts — effects they associate with climate change and with changes in both the incidence and the severity of diseases. Some 91% of farmers are familiar with the symptoms of rice diseases, but few, if any, regularly practise any form of disease control.

It has long been known that the most effective way to help farmers overcome diseases is to provide them with rice cultivars that are resistant to those diseases. In East Africa, the commonest rice diseases are bacterial blight, blast (a fungal disease) and *Rice yellow mottle virus*.

In response to this challenge, Germany's Federal Ministry for Economic Cooperation and Development (BMZ) funded a 3-year project, 'Mitigating the impact of climate change on rice disease resistance in East Africa' (MICCORDEA). The project focused on bacterial blight and blast in Rwanda, Tanzania and Uganda.

"Perhaps the most important outcome of the project is that we have a number of national scientists qualified at master's and doctoral levels in the three countries," says Drissa Silué, AfricaRice plant pathologist who drafted the final report. (The project was conceived and implemented by former AfricaRice plant pathologist Yacouba Séré.) "This means that there are now scientists in place in the national programs who can carry out research on rice diseases in general and on these two diseases in particular."

An immediate upshot of this has been the mapping of the distribution and severity of bacterial blight and blast across the three countries. "This is the first time that we have had detailed maps of the distribution of these diseases in East Africa, which will help target breeding efforts," says Silué. This work has also established baseline data for measuring changes in disease patterns as climate change takes hold over the coming decades.

The causal organisms of both diseases are highly variable. The variability of blast pathogens is demonstrated by the gene-for-gene theory of genetic resistance — specific resistance genes in rice prevent infection by specific virulence genes of the pathogen. Over 70 major resistance genes have been documented for blast in rice worldwide. Meanwhile, over 30 resistance genes for bacterial blight are known, some of them in native African rice species such as *Oryza barthii*, *O. glaberima* and *O. longistaminata*.

In the MICCORDEA project, rice germplasm known to be carrying resistance genes was screened at disease hot spots in each of the three countries. This is a quick and cheap way of identifying material resistant to local strains of the pathogens and, in the case of blast, the pathotypes prevalent in each hot spot.

Bacterial blight

From the work conducted by Rwanda Agricultural Research Institute (ISAR), Rwanda seems to have the most complex distribution of variation in the two diseases, with both registering considerable diversity across sites. For bacterial blight, two of the sites registered three pathotypes/resistance groups each, but the third site registered uniform moderate resistance across rice lines. No candidate resistant varieties for use in a bacterial blight-resistance breeding program emerged from this work. However, in a separate experiment conducted by the Rwanda Agriculture Board (RAB), five cultivars proved resistant to all bacterial blight isolates.

In Tanzania, researchers at the Agricultural Research Institute in Uyole found two lines resistant to bacterial blight that show promise for inclusion in the country's

bacterial blight-resistance breeding program. Research testing rice genotypes against five strains from bacterial blight hot spots across the country revealed large variations across seasons and sites, suggesting the worrying prospect of genetic shifts in pathogen populations. However, six genotypes were resistant to four of the site-specific strains of the disease.

In Uganda, the National Agricultural Research Organisation (NARO) and National Crops Resources Research Institute (NaCRRI) found no lines completely resistant to bacterial blight, and just two lines showing moderate resistance. However, in a test of five cultivars against the three most aggressive isolates, AfricaRice's WITA 9 and NERICA 4 performed best.

In parallel with the fieldwork in East Africa, Georg-August University of Göttingen, Germany, conducted diversity, virulence and toxin production studies on bacterial blight. A major result from the diversity studies was the diagnosis of bacterial blight isolate Ug12 from Uganda. Meanwhile, the virulence studies identified two genes that conferred broad resistance to bacterial blight — one providing strong resistance and the other moderate resistance. The research also confirmed that African strains of the blight bacterium are distinct from those found in Asia. The toxin production study led the research team to speculate that a low-molecular-weight toxin may be present but not playing a major role in bacterial blight virulence.

Blast

The results of ISAR's blast screening were more promising than those of its bacterial blight screening, with at least two and up to seven genotypes (each with between one and four resistance genes) showing promise for disease control at each of the three hotspot sites. An inoculation test using the five most virulent isolates of blast against recently released cultivars showed that Rumbuka has broad resistance to all five isolates, while Mpembuke is resistant to two of them. This information should help the extension service target areas for promotion of these new cultivars.

The upland site of Kyela in southern Tanzania has a particularly diverse and aggressive blast population, which destroyed up to 75% of the rice lines tested, the disease being at its worst early in the rainy season. However, even here, the screening revealed 10 resistant lines (9 with monogenic resistance, 1 with a four-gene combination). These 10 lines have been recommended for use in a breeding program to 'pyramid' (i.e. combine) the resistance genes in popular local varieties that are susceptible to the disease.

Five rice lines showed stable resistance to blast across four hotspot sites in Uganda (4 monogenic, 1 with a combination of two genes). Moreover, five accessions (i.e. varieties or landraces originally collected in the field rather than from breeders) also performed well in these hot spots. These accessions include the well-known varieties IR24 and AfricaRice's own NERICA 1. All these materials were recommended for inclusion in the effort to pyramid resistance genes.

In Germany, institutions at three universities — the Institute of Plant Pathology and Plant Protection, the Karlovsky lab and the Section for Tropical and Subtropical Agriculture and Forestry (SeTSAF) at the Georg-August University of Göttingen; the Institute of Plant Diseases and Plant Protection at Leibniz University, Hannover; and the University of Applied Sciences of Erfurt — investigated the population structure, pathogenicity and mating type of blast pathogens in preparation for further studies on the impact of climate change on disease incidence and severity. Some 88 blast isolates were used to determine variation in virulence among isolates. The research into mating type revealed the possibility of recombination via sexual reproduction of the blast fungus in East Africa, though this has never been proved to occur in the field.

Resistance analysis in Germany identified two genes with potential for use in East Africa, while a study of cultivar reaction to blast strains demonstrated that NERICA 4 has broad-spectrum resistance to East African strains, though the genetic basis for this is

as yet unknown. This makes NERICA 4 potentially doubly interesting, given the resistance to bacterial blight demonstrated in Rwanda.

How will climate change affect disease patterns?

A central aim of the project was to work toward mitigation of the impact of rice diseases as East Africa's climate changes. The degree studies and short-course training provided for national scientists are a major component of this, as they will give rise to continuing activities over the coming years, enabling scientists to respond to farmers' changing needs. However, the project also included a component of research to find out how the two diseases are likely to affect the East African rice crop as temperature increases and rainfall becomes more erratic.

The crop model RICEPEST, which determines rice losses to diseases under current climatic conditions, was an obvious place to start. To develop future scenarios, the climate model EPIRICE was used to generate data on projected climate to feed into RICEPEST. This was the first time these two models had been combined. For blast, the news for farmers is good: although it can be locally virulent, the disease currently has a relatively minor impact on rice yields in the region as a whole, and this is predicted not to change in the foreseeable future. The combined model predicted a less than 2.5% probability of blast epidemic outbreak in Tanzania, with low yield losses (no more than 0.017 t/ha) due to blast up to 2050 (i.e. 35 years hence). However, the news is not so good regarding bacterial blight: this disease is predicted to reduce yields by between 0.47 and 0.67 t/ha by 2050. The implication is that, for East Africa, breeding efforts should focus far more on resistance to bacterial blight than to blast.

Georg-August University tested six blast-resistance genes in two genetic backgrounds at two temperatures against a Tanzanian strain of blast. The research found that, in general, both temperature and genetic background tend to affect resistance. However, the good news is that two of the resistance genes were not affected by either temperature or genetic background, providing strong resistance in all cases. Parallel research showed that rice reactions to blast and temperature are both genetic.

A major stress under predicted future climate scenarios will be drought. If rainfall becomes more erratic, rainfed rice in particular is likely to suffer yield losses as it undergoes increasingly long and severe dry spells during the growing season. Drought resistance[2] in rice is complex: there is no major drought-resistance gene, but rather a number of small-effect genes whose impact is cumulative, so that the more of these genes a plant has the more resistant it is. These genes are collectively known as 'quantitative trait loci' (QTLs). Project research demonstrated that rice plants with a selection of drought-resistant QTLs were more susceptible to bacterial blight than those without them. Moreover, rice lines with both the drought QTLs and a bacterial blight resistance gene suffered more severely from the disease under drought conditions than under 'normal' conditions. This apparent breakdown in resistance would seem to be a major problem, until one looks at parallel research which showed that the effects depend very much on the gene-for-gene alignment of rice resistance with pathogen virulence. With the right bacterial blight-resistance gene combined with drought-resistance QTLs, rice plants displayed *increased* resistance to the disease under drought.

The other major component of climate change is temperature. Over the coming decades, East African rice systems are likely to experience gradually increasing temperatures, especially night-time temperatures during the growing season. Two bacterial blight-resistance genes were studied: higher temperatures enhanced the resistance effects of one while reducing the effects of the other!

2. Although at the whole-plant level, drought would seem to be tolerated rather than resisted, in physiological terms rice plants *resist* the effects of drought.

Clearly, climate-proofing rice against bacterial blight is going to be a complicated business.

Another avenue is to tap the resistance genes of *O. glaberrima*, ensuring these enter the widely grown *sativa* cultivars. To this end, 18 *O. glaberrima* accessions were screened, including 9 that had demonstrated resistance to many Philippine strains of bacterial blight. These accessions were screened against 14 strains of the blight bacterium at two temperatures. Four of the accessions showed broad-spectrum resistance at high temperature. One of these carries a known resistance gene, but the others are still being tested to see whether they carry known resistance genes or novel ones.

Project achievements

"I believe that the project has done what we wanted it to. It has made a significant contribution to preparing the rice production sector for future climate change," says Silué. "We have a gene for bacterial blight resistance that currently stands up to most of the bacterial blight in East Africa. We also have a pair of genes for blast that not only show durable resistance today, but also seem to be effective at higher temperatures. This means we have the basic tools for climate-proofing existing and new varieties for East Africa.

"The other element of climate-proofing is having the skills on the ground to continue to study the diseases as they evolve over the coming years. This is what the master's and doctoral training was all about."

All in all, then, a successful project, though there is no room for complacency. Much hard work both in the lab and in farmers' fields remains to be done in future years to enable East Africa's rice sector to cope effectively with the disease challenges associated with climate change.

Beyond boiled rice — partners and products

Traditionally, rice is eaten around the world as a basic starchy (carbohydrate) staple, perhaps with the major exception of rice noodles in eastern Asia. However, there are good reasons for doing more with rice than simply boiling it.

The first of these is to add value to lower grades of rice. Local rice has historically been unpopular in

National scientist trainees getting to grips with rice disease isolation and purification techniques (inset) at a training course in Dar es Salaam, Tanzania, 19–27 August 2011

many parts of Africa because of its quality — it is often perceived as heterogeneous, impure and unclean compared with clean, white, uniform imported rice, and consequently sold at lower prices on local markets. One particular issue has been the quality of milling, which often leaves local rice as a mixture of sizes of broken grains. There are a few cultures that actually prefer broken grains — notably Senegal (and even here, it is broken rice of uniform granulation that is preferred) — but, for the most part, broken rice is considered inferior to unbroken rice and therefore of lower value.

With many countries having increased their rice production over a number of years, some markets have experienced a glut of local 'inferior' rice, which has not met with universal acceptance. Rather than let this rice go to waste, AfricaRice has in the past developed (or sought out) recipes to make use of it, thereby adding value to it. The simplest route was that followed historically by those promoting other starchy staples such as potato: grind it up to make flour. Rice flour (cheaper in many parts of the tropics than imported wheat flour) can then be used as a substitute for wheat flour in typical flour-based foods, such as bread and cakes. Rice flour is a particularly good substitute for wheat flour for those who are gluten-intolerant. It is also used as a thickening agent in recipes that are refrigerated or frozen, since it inhibits liquid separation.

"Over the past year or two, we have decided that this is not enough!" declares AfricaRice grain-quality specialist John Manful. "We are now looking at adding nutritional value to rice." This is being done via several routes with a range of partners.

AfricaRice has been working with Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) to 're-engineer' a rice-based steamed product, *ablo*, using lower-grade rice grains. The re-engineering comprises standardizing processing operations, recommending best practices and identifying local varieties best suited for *ablo* production.

A raw white rice grain is primarily carbohydrate (about 80%), water (*c*.12%) and protein (*c*.7%); it is not rich in any macro- or micronutrients or vitamins. As such it does not have a particularly balanced nutritional value. "One approach is to incorporate more nutritious food sources into rice flour," says Manful, "such as grain legumes for protein and fruits for minerals and vitamins. In particular, we have made flour rich in minerals and vitamins from dried safou [a forest fruit of West and Central Africa popular in Cameroon], which we have then mixed with rice flour." The composite flour has been used to make biscuits (cookies) and pastries in Cameroon and Nigeria, where the field-tested products are ready for commercialization.

"Another approach is to fortify rice directly with a range of minerals and vitamins," says Manful. AfricaRice's partners in this venture are Louisiana State University (USA) and the Wright Group (Crowley, LA, USA). The Wright Group has a history of rice fortification dating back to 1894. The technique that is being trialed for Africa is a 'rinse-resistant technology': in excess of 80% of the fortification coating remains on the rice grains during washing and cooking — this resistance has been and continues to be verified by Louisiana State University.

With the technology available, the big question was whether the fortified rice would be acceptable to consumers. "We blended fortified rice with 'regular' rice, and then made biscuits, boiled rice and porridge [a rice version of oatmeal], which we presented to taste panels in Benin and Ghana," Manful explains. Could they detect the fortification? Would there be a negative reaction to it? "At very high levels of fortification, *some* of the taste-testers could tell that the fortified rice was different from 'regular' rice," says Manful. "Remarkably, however, they actually preferred the taste of the fortified rice!" Thus, a potentially major hurdle was overcome: there was no adverse reaction from the consumers to this fortification of rice.

"The beauty of this technique is that, if we have a rice-eating population that has a diet deficient in some

mineral or vitamin, or combination of those, then we can make a specific fortification formula with the deficient nutritional elements and coat their rice with it," says Manful. This will ensure that populations get exactly what they need — no more, no less.

"There is an additional benefit to this kind of nutritional fortification," says Manful. "It is an additive; we are not manipulating the genetics of the rice itself." For whatever reason, there is still strong opposition in many parts of the world to genetically modified (GM) food, which limits the potential scope of advancements such as 'Golden Rice' (rice genetically fortified with vitamin A). "The anti-GM lobby has no argument about the kind of fortification we are testing," says Manful.

Moreover, the fortification through coating can be applied to any rice. So a target community can continue to eat its preferred varieties, rather than having to adopt new varieties to meet its nutritional requirements.

AfricaRice is now working with the Wright Group and Louisiana State University to see how the technology can be adopted by private-sector small and medium-sized enterprises in Africa to make it commercial.

The fortification of rice-based products is particularly targeted at children and pregnant women, who are perhaps the most nutritionally sensitive elements of any society. Louisiana State University is leading the validation of the positive effects of consumption of fortified rice on malnourished children. AfricaRice is also targeting digestive problems, particularly type 2 diabetes and gluten-related disorders. Many readers may not be aware that these two disorders are increasing within the populations of developing countries, just as they are in developed countries.

A selection of nutritionally enhanced rice-based products from various members of the Africa-wide Rice Processing and Value Addition Task Force

AfricaRice is working with the University of Milan to develop rice pastas. Who better to work with on pasta than an Italian university? "We are testing 100% rice pasta," explains Manful, "which has advantages over both wheat pasta and boiled rice." Rice is gluten-free, which means that it is a good starchy staple for those with gluten-related disorders. It has also been shown that rice pasta is more slowly digested than boiled rice, which aids in the management of type 2 diabetes. "We have developed many rice-pasta products," says Manful, "for which we are currently conducting consumer tests."

Parboiling (boiling or steaming paddy prior to milling) is becoming increasingly popular as a means of improving the quality and milling recovery of local rice in several parts of Africa. A secondary effect of parboiling is that it slows the digestion rate of rice. Having introduced improved parboiling techniques to several countries in the region (most recently through the rice sector development hubs), AfricaRice is now working with McGill University (Canada), the University of Milan and NARS partners in Cameroon, Ghana and Nigeria to improve the parboiling process to optimize the digestive rate of rice for those with type 2 diabetes.

"All of this work is being carried out under the broader framework of the Africa-wide Rice Processing and Value Addition Task Force," says Manful, "and validated technologies from the research are shared with all partners within the task force."

Smart-valleys

The 'Sawah, market access and rice technologies for inland valleys' (SMART-IV) project, which ran from 2009 to 2014, developed a method for the participatory development of inland valleys for rice-based systems. In 2014, the method was renamed from 'Sawah system development' to 'Smart-valleys', which is also the name of the follow-up project to SMART-IV.

The method itself has already been described in detail (*see* 'Working with farmers to improve water control in inland valleys', *AfricaRice annual report 2012*, pages 14–16). In summary, the Smart-valleys approach involves five steps:

1. Raising farmers' awareness of the system
2. Clearing the land
3. Designing the system
4. Implementing the system (putting the infrastructure in place)
5. Cultivating rice.

Since 2014, the project has focused on scaling up the method to more inland valleys. Originally promoted and implemented in Benin (5 sites) and Togo (7 sites), the Smart-valleys method had been extended to 139 sites by the end of 2014.

Scaling up

Scaling-up has been accomplished in partnership with national partners Cellule Bas-Fond (CBF, Benin) and Institut togolais de recherche agronomique (ITRA, Togo), plus three NGOs in Togo: Entreprises, territoires et développement (ETD), Groupe de recherche-action pour l'éducation au développement (GRED) and Women in Law and Development in Africa (WiLDAF). There are two main elements of the scale-up: capacity-building and demonstration sites.

The project also set about raising the visibility of the Smart-valleys method within the countries. A 'harvest celebration' was held in Benin, to which officials from the extension service, the Agricultural University of Kétou and the Ministry of Agriculture, Livestock and Fisheries were invited. Smart-valleys was also showcased at the 'Rice Innovations Fair' held at AfricaRice Cotonou for the agricultural development sector, including representation from the Embassy of Japan in Benin, farmer organizations and NGOs (*see also* 'Scalable rice technologies', page 58). The project also contributed to the national strategy for

Scenes from Smart-valley developments in Kara region, northern Togo

inland-valley development in Benin that is being developed by the Ministry of Agriculture, Livestock and Fisheries.

A set of three training sessions was developed for field technicians from the extension services, ministries of agriculture and NGOs. These comprised: (1) Smart-valley site selection and validation; (2) participatory development of the inland-valley site; and (3) maintenance of the site (infrastructure) and soil-fertility management. Separate sessions were also provided for lead farmers to enable them to act as peer trainers in their inland valleys.

Smart-valley promotion has targeted the three agroecological zones in each country, establishing demonstration sites in each zone. The demonstration sites were used not simply for demonstrating the technique, but also for the training sessions and additional 'on-the-job' training of farmers.

Nine training sessions — site selection and validation (4), participatory development (2), site maintenance (2) and lead farmers (1) — held between November 2011 and August 2014 reached over 148 field technicians and about 47 lead farmers. Meanwhile, the 'on-the-job' training reached an additional 502 local farmers. Further sessions on participatory development and site maintenance were planned for 2015; the latter under the Togolese National Agricultural Development Project (PADAT).

A 40-minute video was produced as an additional awareness-raising and training tool, and a guide for field technicians is being prepared. With these, plus the field technician and lead farmer curricular, scaling up should be further accelerated.

Adaptation and benefits

In 2014, Smart-valleys were established at 39 sites in Benin, covering 101 ha and involving 446 farmers (231 of them women). Meanwhile, in Togo the figures were 100 sites, 132 ha and 1040 farmers (587 women).

Adoption of the Smart-valleys approach has increased farmers' average rice yields and gross margins. In Benin, for example, gross margins from Smart-valleys averaged FCFA344,249 (US$ 700) per hectare, compared with FCFA129,456 ($260) for traditional rainfed cultivation. The large increase 'attributable' to the Smart-valleys approach in Benin was aided by the farmers' use of certified rice seed, as demonstrated by the figures from Togo (where certified seed was not used): FCFA253,990 ($500) for the Smart-valleys and FCFA165,746 ($360) for traditionally managed rice.

Some 52 farming 'systems' that included the Smart-valleys approach were identified. The most profitable

was Smart-valleys applied in lowland plus fertilizer (nitrogen, phosphorous and potassium [NPK], and urea), NERICA varieties and no herbicide, with a gross margin of FCFA503,197 ($1000).

The future

The approach will be further integrated with the activities of the AfricaRice rice sector development hub. The second phase of the Smart-valleys project will focus on the evaluation and introduction of tools in the Smart-valleys sites to improve rice production while reducing labor. These include *Rice Advice*, mechanical weeders and reapers. The second phase of the project will also see expansion into Liberia and Sierra Leone.

In Benin, the approach is being used in a new project funded by the Islamic Development Bank. It is also being included in proposals for further scaling out the approach in Benin and Togo.

Mural at AfricaRice Sahel regional station, Ndiaye, Saint-Louis, Senegal

Donor profile — Bill & Melinda Gates Foundation

The Bill & Melinda Gates Foundation was created in 2000 by the merger of the William H. Gates Foundation and the Gates Learning Foundation. Today it is the largest private philanthropic foundation in the world. The Foundation works to help all people lead healthy, productive lives. In developing countries, it focuses on improving people's health and fighting hunger and poverty. The Foundation's interest in and support for rice predates its own existence. It has been a long-term supporter of the International Rice Research Institute (IRRI) and of AfricaRice, mostly through IRRI.

Focus on breeding

All of the projects at AfricaRice funded by the Bill & Melinda Gates Foundation are breeding projects targeting specific traits. "Some of AfricaRice's earlier breeding programs and projects were not necessarily product oriented," says Takeshi Kumashiro, leader of the AfricaRice Genetic Diversity and Improvement Program. "'Product-oriented' breeding is nothing new — it is common sense. All breeding programs have to have a clear product image, reflecting needs of farmers, consumers and other stakeholders, since breeding takes a long time and demands lots of resources."

When Kumashiro arrived at AfricaRice in 2010, he emphasized a number of points to the other breeders:

- product-oriented breeding — determining the traits required in new varieties;
- phenotyping — a key factor in breeding success;
- breeding efficiency — using molecular markers, and shortening the variety-development time;
- database — *all* data to be stored for sharing;
- product liability — Breeder Seed needs to have 100% genetic purity, and the variety catalog needs descriptions based on real *data*.

Increasing rice yield under abiotic stress

The yield of rice under rainfed conditions is held back by abiotic stresses. These are the stresses that are not inflicted by biological organisms, but rather are a part of the growing environment or climate where the rice is being cultivated. In Africa, rainfed rice yields average about 2 t/ha across the continent. Better tolerance or resistance to abiotic stresses should increase those yields significantly.

In March 2008, IRRI and AfricaRice launched the first phase of the project 'Stress tolerant rice for poor farmers in Africa and South Asia' (STRASA), which the Foundation funded through IRRI. The Gates Foundation wants to reignite a green revolution in rice in Africa and South Asia, by getting new rice technologies into the hands of resource-poor farmers. The aim was to increase yields by 1 t/ha when the rice is grown under the abiotic stresses in question. The project is currently in its third phase.

The project targets drought, salinity, submergence, iron toxicity and cold (low temperature). It involves 18 countries in Africa, with AfricaRice leading the project in 14 countries in West Africa, and IRRI in 4 countries in East and Southern Africa (*see* Table 2, next page).

The project takes a multi-pronged approach. At the onset of the project, cultivars for which there was strong farmer demand but poor seed supply were identified by the national agricultural research system (NARS) partners. These cultivars plus a selection of stress-tolerant cultivars deemed suitable for various African contexts were then multiplied and disseminated, developing a model to be followed later once the project had developed new stress-tolerant cultivars. The NARS received direct funding for the seed production work.

Meanwhile, AfricaRice and NARS scientists made targeted crosses between varieties with known abiotic-stress tolerances and African 'mega varieties' (i.e. cultivars that are popular with farmers across a number of countries) and other high-yielding varieties. Conventional approaches using pedigree breeding as well as molecular breeding approaches using marker-assisted selection are then used to select new rice varieties combining abiotic-stress tolerance with high yield and good grain-quality traits. Concurrently with such breeding experiments, basic research was conducted to identify genes and quantitative trait loci (QTLs) in cultivars known to be resistant to specific abiotic stresses under African conditions, but for which the genetic basis of the resistance was unknown. Once the genes or suitable markers were identified, these were also included in the molecular breeding program.

Another component of the project is capacity-building, targeting NARS partners, seed producers and farmers with training in the areas of breeding, seed production, women in leadership and enterprise management, impact assessment, experimental data collection, analysis and management, and participatory varietal selection (PVS). Capacity-building also included the establishment or rehabilitation of seed stores and drying floors in 12 project countries. Another component of the project aimed at diffusing rice technologies which would promote good agricultural and postharvest practices was the use of videos (AfricaRice's 11 'Rice Advice' farmer-to-farmer videos — *see* Box '"Rice Advice" farmer-to-farmer videos'). A new video was also made by the project to train NARS partners in PVS.

During the first 6 years of project implementation in Africa (2008–2013), some 19,260 t of seeds of popular and stress-tolerant rice cultivars was produced, reaching an estimated 700,000 farmers. Meanwhile, 42 stress-tolerant cultivars were released in 12 countries as a direct result of STRASA activities (Table 3, page 38),

Table 2. STRASA target stresses: Activities by country

Country	Drought	Submergence	Salinity	Iron toxicity	Cold
Benin	×				
Burkina Faso	×			×	
Burundi		×	×		
Côte d'Ivoire	×				
Ethiopia					×
The Gambia			×		
Ghana				×	
Guinea				×	
Kenya	×		×		
Madagascar				×	×
Mali	×	×	×		×
Mozambique	×	×	×		×
Nigeria	×		×		
Rwanda					×
Senegal			×		×
Sierra Leone		×	×		
Tanzania	×				
Uganda	×				

'Rice Advice' farmer-to-farmer videos

- Seed sorting: *Spotted seed means diseased seed*. Rural Development Academy, Bogra and TMSS, Bangladesh.
- Seed flotation: *Seed sorting by flotation*. Rural Development Academy, Bogra and TMSS, Bangladesh.
- Seed drying: *Well dried seed is good seed*. Rural Development Academy, Bogra and TMSS, Bangladesh.
- Seed preservation: *Rice seed preservation*. Rural Development Academy, Bogra and TMSS, Bangladesh.
- *Land preparation*. Africa Rice Center, Benin and Institut de l'envrionnement et de recherches agricoles (INERA), Burkina Faso.
- Seedbed: *The seedbed*. Africa Rice Center, Benin; Institut d'économie rurale (IER), Mali; Intercooperation – Sahel; Institut de l'environnement et de recherches agricoles (INERA), Burkina Faso; and farmers in Niona, Zamblara, Zéguesso and Zianso, Mali.
- Transplanting: *Rice transplanting*. Africa Rice Center, Benin; IER, INERA, Intercooperation – Sahel, Burkina Faso; and farmers in Niona, Zamblara, Zéguesso and Zianso, Mali.
- Weed management: *Effective weed management*. Africa Rice Center, Benin; IER, INERA, Intercooperation – Sahel, Burkina Faso; Institut sénégalais de recherches agricoles (ISRA), Senegal; Société d'Aménagement et d'Exploitation des terres du Delta et des vallées du fleuve Sénégal et de la Falémé (SAED), Senegal; and farmers in Niona, Zamblara, Zéguesso and Zianso, Mali.
- Soil fertility: *Managing soil fertility for healthy rice*. Africa Rice Center, Benin; IER, Mali; Intercooperation – Sahel; farmers in Niona, Zamblara, Zéguesso and Zianso, Mali; and farmers in Ouèdèmè, Benin.
- *Improving rice quality*. West Africa Rice Development Association.
- Parboiled rice: *Cashing in with parboiled rice* (2005). WARDA; Sasakawa Global 2000; Songhai; and INERA, Burkina Faso.

Participants at a training workshop on data analysis and management conducted at Saint-Louis, Senegal, in August 2014 with support from STRASA and GSR projects

including 6 that were given the ARICA designation by the Africa-wide Rice Breeding Task Force (*see* 'Naming of second batch of ARICAs', page 51). AfricaRice has worked with the NARS to develop 'seed roadmaps' to predict where in the countries there will be demand for seed of specific cultivars to enable targeted multiplication of the new cultivars.

"STRASA has generated a level of enthusiasm among our NARS partners that I've never seen before," says Baboucarr Manneh, AfricaRice Irrigated Rice Breeder and coordinator for the Africa component of STRASA. "In fact, AfricaRice has had complaints from several non-STRASA countries for not being included in the project. This demonstrates the clear need for rice varieties that are tolerant to abiotic stresses across the continent."

The key to STRASA's popularity seems to lie in the strong collaboration that it fosters among partners. The project adopts the breeding task force network and PVS mechanism for germplasm evaluation, so that NARS scientists (particularly breeders) and their partners are fully involved in the selection process to obtain the best cultivars for their own farmers and consumers.

Table 3. STRASA-developed cultivars released by country

Country (no. cvs)	Cultivar	Growing environment	Characteristics	Released
Benin (6)	Cnax 3031-78-2-1	Upland	Drought tolerant	2013
	ART3-9L6P2-B-B-1	Upland	Drought tolerant	2013
	WAB368-B-2-H2-HB	Upland	Drought tolerant	2013
	IR 68702-072-1-4-B	Upland	Drought tolerant	2013
	WAB99-17	Upland	Drought tolerant	2013
	Art3-7-L16p5-B-B-3	Upland	Drought tolerant	2013
Burkina Faso (7)	WAB-C-165	Upland	Drought tolerant	2013
	WAB99-84	Upland	Drought tolerant	2013
	WAS122-IDSA-1-WAS-6-1	Lowland	Iron-toxicity tolerant	2013
	WAS 20-B-B-1-2-2-2	Lowland	Iron-toxicity tolerant	2013
	WAT1046-B-4-3-2-2-2	Lowland	Iron-toxicity tolerant	2013
	IR75866-2-7-1-WAB-1	Lowland	Iron-toxicity tolerant	2013
	IR75884-12-12-14	Lowland	Iron-toxicity tolerant	2013
The Gambia (2)	IR 71829-3R-28-1	Mangrove	Salinity tolerant	2013
	IR 72402-B-P-25-3-1-B	Mangrove	Salinity tolerant	2013
Ghana (1)	IR841	Lowland	Iron-toxicity tolerant	2013

Country (no. cvs)	Cultivar	Growing environment	Characteristics	Released
Guinea (3)	IR 75887-1-3-WAB1	Lowland	Iron-toxicity tolerant	2013
	WAT 1046-B-43-2-2-2	Lowland	Iron-toxicity tolerant	2013
	WAT 1297-B-57-1-2	Lowland	Iron-toxicity tolerant	2013
Ethiopia (4)	Hibbire (IRGA370-38-1-1F-B1-1)	High elevation	Cold tolerant	2013
	Chewaka (YINLU20)	High elevation	Cold tolerant	2013
	Kallafo (FOFIFA 3737)	High elevation	Cold tolerant	2013
	Hiddassie (WAB 515-B-16A1-2)	High elevation	Cold tolerant	2013
Kenya (1)	IR05N221	Rainfed/ Irrigated	Drought tolerant	2013
Mali (7)	DKA-P2	Upland	Drought tolerant	2011
	DKA-P3	Upland	Drought tolerant	2011
	DKA-P16	Upland	Drought tolerant	2011
	DKA-P17	Upland	Drought tolerant	2011
	DKA-P27	Upland	Drought tolerant	2011
	WAS 62-B-B-14-1-4-2 (Sutura)	Irrigated	Cold tolerant	2011
	WAS 49-1-9-4-3 (Saku)	Irrigated	Cold tolerant	2011
Mozambique (1)	M'ziva (IR 7708)	Lowland	Drought tolerant	2012
Sierra Leone (3)	NERICA-L 19	Lowland	Iron-toxicity tolerant	2012
	WAR 73-1-M2-1	Mangrove	Salinity tolerant	2012
	WAR 77-3-2-2	Mangrove	Salinity tolerant	2012
Tanzania (1)	Tai (IR 03a262)	Lowland	Drought tolerant	2012
Uganda (5)	WAB 95-B-B-40-HB (ARICA5)	Upland	Drought tolerant	2013
	Namche-2 (Nm7-29-4-B-P-80-8)	Upland	Drought tolerant	2013
	Nm7-27-1-B-P-77-6	Upland	Drought tolerant	2013
	Nm7-5-2- B-P-79-7	Upland	Drought tolerant	2013
	Namche-1 (ART3-11L1P1-B-B-2) (ARICA4)	Upland	Drought tolerant	2013
Total	42 released cultivars			

Bringing Chinese rice technologies to Africa

China is the ancestral home of rice, with a long history of rice cultivation, and remains the largest producer of rice in the world (not surprising when its 1.4 billion population consumes an average of 76.8 kg milled rice per person per year). Thus, the Chinese have had plenty of time to develop advanced cultivars and other technologies to fine-tune its rice production sector.

China has built the world's largest capacity in rice breeding. The 'Green super rice' (GSR) project was launched in 2009 to make Chinese rice varieties accessible to rice researchers and rice farmers in Africa and Asia. This project will take advantage of China's breeding capacity and major scientific advances in plant genomics and molecular breeding for poverty alleviation by developing and adopting GSR hybrid and inbred cultivars in eight countries in Africa, four in Southeast Asia and three in South Asia. GSR cultivars are expected to have good resistance or tolerance to major abiotic and biotic stresses of rice and thus have more stable yield. The project partners are AfricaRice, the Chinese Academy of Agricultural Sciences (CAAS), IRRI and the NARS of the target countries on the two continents. The Gates Foundation funding flows through CAAS to AfricaRice and its partner NARS. The main focus is on cultivar development and dissemination.

The Africa component started in earnest in 2008, with AfricaRice implementing the project in eight countries (Ethiopia, Liberia, Mali, Nigeria, Rwanda, Senegal, Tanzania and Uganda). In the first phase (2008–2011), most of the Chinese cultivars succumbed to African rice gall midge (AfRGM), *Rice yellow mottle virus* (RYMV) and African races of the blast fungus.

"The 'green' in the GSR means environment-friendly," says Kumashiro: "less chemical fertilizers and less chemical pesticides. Thus, it assumes that germplasm provided (developed) by the CAAS carries high yielding capacity under less inputs of fertilizer, plus resistances to biotic stresses. The latter was not achieved in CAAS's initial germplasm in Africa, which succumbed to AfRGM and RYMV. This is natural because both are indigenous to Africa."

Consequently, the second phase of the project (2012–2015) is using African rice germplasm as donors for local adaptation (including resistance to AfRGM, blast and RYMV). In the second phase, AfricaRice is taking the lead in West Africa (Mali, Nigeria and Senegal), while IRRI is coordinating activities in East and Southern Africa (Burundi, Ethiopia, Mozambique, Rwanda, Tanzania and Uganda). Bulk segregating populations from CAAS (comprising F_2, F_3 and BC_1F_2 populations) have been evaluated at sites in Mali, Nigeria and Senegal that are key sites for phenotyping for high yield potential, drought, alkalinity, iron toxicity, bacterial blight, blast, RYMV, AfRGM and salinity. For promising lines, controlled screening for blast resistance is conducted in Benin.

Further down the road of selection, promising pure-breeding lines are nominated to the Africa-wide Rice Breeding Task Force trials, starting with the Multi-Environment Trial for irrigated and rainfed lowland rice-growing environments. Thus, through the breeding task force, GSR lines are made available to all AfricaRice member states and other task-force participant countries beyond the GSR target countries.

By the end of 2014, Mozambique, Rwanda, Tanzania and Uganda had released GSR cultivars, and Mali and Senegal had cultivars in the pipeline for release.

The national partners have developed seed roadmaps and formed partnerships with seed producers in all project countries. Thus, once GSR cultivars are available, seed will be given to the commercial sector to produce Certified Seed for farmers.

The project also has a capacity-building component, with NARS scientists and technicians and seed producers being trained in molecular breeding techniques, and seed production and commercialization. Seed training is conducted for technicians at AfricaRice followed by

in-country training by these trainers of seed producers, which has reached more than 100 partners in the eight countries.

"Like STRASA, GSR is also producing good results," says Manneh, who is also coordinator of the African component of GSR, "with adapted varieties outyielding the checks and starting to be released."

STRASA and GSR coordination meeting at the Third Africa Rice Congress, Yaoundé, Cameroon, October 2013

Diffusion and impact of improved varieties in Africa

The 'Diffusion and impact of improved varieties in Africa' (DIIVA) project was funded by the Gates Foundation through Bioversity International. The project was designed to update, widen and deepen an initiative in the late 1990s that estimated the adoption of 'modern varieties' across sub-Saharan Africa (yielding an overall estimate of "about 22% of the growing area of primary food crops"). AfricaRice was one of eight CGIAR centers involved in DIIVA, as the key center for rice.

The DIIVA partners first defined 'modern varieties' "as improved varieties released after 1970 that are available for adoption because of crop improvement efforts in the public or private sectors," says the CGIAR Standing Panel on Impact Assessment (SPIA) brief that summarizes the project results. They "also include 'escapes', products of participatory varietal selection from improved materials, and breeding outputs in countries that do not have a functioning formal release and registry system. Released varieties that are local landraces are not counted as [modern varieties] in their country of origin." Adoption estimates were primarily generated through expert opinion, but DIIVA also drew on its own adoption studies, other adoption studies, inferences from the literature, and seed production and trade figures.

DIIVA calculated that, in 2010, modern varieties covered 35% of the area for 20 primary and secondary food crops across sub-Saharan Africa. About 3500 improved cultivars had been released for these crops since 1970, and more than 1150 improved varieties and hybrids had been adopted by farmers.

The data generated by AfricaRice in 19 of the project's 20 focal countries showed that modern rice varieties covered 2,582,317 ha out of a total rice area of 6,787,043 ha, i.e. a 38% adoption rate.

The study drew a number of conclusions on adoption of modern crop varieties:

- Low investment causes low adoption.
- Countries differ greatly in adoption behavior.
- The CGIAR contribution to adopted modern varieties was in excess of 80%.
- Market forces play a major role in adoption (highlighted by high scores for commercial maize, soybean and wheat).
- There is an absence of widely adapted varieties in Africa (notable exceptions included NERICA 1).

"The results of the DIIVA project show that it is possible to establish a comprehensive benchmark on the diffusion of [modern varieties] in [sub-Saharan Africa] for a relatively small quantity of resources," according to the SPIA brief. "Extrapolating past performance to the future suggests a target of around 50% … adoption by 2020."

The Foundation's views on plant breeding across CGIAR

In 2013, the Gates Foundation sponsored and convened a meeting on 'Delivering increased rates of genetic gain to smallholders: Bringing the breeding technology revolution to Africa and South Asia', to which scientists from the main CGIAR breeding programs, private companies, national programs in Africa, US Department of Agriculture and universities were invited. By pointing out difference in the genetic gain between many public breeding programs (0.5%) and private companies' breeding programs (2.0%), the Foundation indicated that raising the rate of genetic gain from less than 1% to more than 2% annually is a key component of the agricultural transformation of public institutions.

The successes of the private sector are due to the breeding style adopted, including: marker-assisted selection (MAS), whole-genome prediction, precision phenotyping, doubled haploids (shortening breeding time), integrated data management, and clear breeding targets.

"If the AfricaRice breeding strategy of the last 5 years is compared with that of the private sector, both are pretty much in accordance, although efficiency of breeding, scale of phenotyping, and management of breeding processes have to be further enhanced," says Kumashiro.

Harnessing abiotic stress tolerance from African rice

In April 2014, a new 5-year project was launched to fast-track gene identification in *O. glaberrima* and rapid transfer into *O. sativa*-based varieties. This is the 'Rapid mobilization of alleles for rice cultivar improvement in sub-Saharan Africa' or RAM (for 'rapid allele mobilization') project, which the Gates Foundation is funding to the tune of US$ 7.5 million.

The project was developed after systematic screening of all *O. glaberrima* accessions (more than 2000 of them) in the AfricaRice genebank showed that some have high tolerance to drought and iron toxicity, and are able to germinate under anaerobic conditions.

The new rain-out shelter at Ikenne, Nigeria: This large (2000 m^2) structure will enable the project to test at least 3500 breeding lines at a time for their susceptibility to drought

The collaborators in the project are AfricaRice, Cornell University (USA), IRRI, the National Institute of Agrobiological Sciences (NIAS, Japan) and, mainly in later phases, the NARS in the target countries (especially Liberia and Nigeria).

Like STRASA, RAM is focusing on abiotic constraints, namely drought, iron toxicity and submergence. Also like STRASA, RAM is strongly focused on applying genomics techniques. "Take, for example, breeding for iron-toxicity tolerance," says AfricaRice lowland rice breeder and project coordinator Ramaiah Venuprasad. "Field testing cannot be done everywhere, but with genomics the phenotyping can be done later in the process, when we have already conducted several generations of marker-based selection."

For the drought-tolerance work, the project is using a site at Ikenne, Nigeria, about 100 km south of Ibadan and 60 km northeast of Lagos. This is a key research site for drought, which has already received major investment. The project has recently installed a large rain-out shelter for the phenotyping work there.

"The drought screening protocol developed in Ikenne is one of our highlights, giving highly repeatable and reliable data on drought tolerance of breeding lines," says Kumashiro. The protocol was developed under STRASA, but is also being used in the RAM project and other drought-tolerance breeding programs.

For the iron-toxicity work, the intention is to use the Suakoko key site in Liberia. However, the Ebola crisis of 2014–2015 has delayed that work. Initially, a consultant will be based in Liberia to initiate the work, to be replaced in due course by a postdoctoral fellow. The senior breeder will visit the site at key stages during the season. Meanwhile, initial crosses for iron-toxicity tolerance were made at the AfricaRice Nigeria station, Ibadan, in 2014.

With the success with the *Sub1* gene,[3] you might have thought that submergence was dealt with, but no. Venuprasad explains: "*Sub1* provides tolerance for one kind of submergence, namely flooding, but we have several types of flooding-related issues. With the *O. glaberrima* work in the RAM project, we're targeting anaerobic germination." When flooding occurs around seeding time, the soil is left without a supply of oxygen — that is, in an anaerobic state. Seeds normally germinate in the presence of oxygen (the aerobic state), but some *O. glaberrima*s will germinate under anaerobic conditions. This is the trait that RAM is planning to introgress into new varieties.

The method being used for all three abiotic stresses is essentially the same. An *O. glaberrima* parent will be the donor of the target gene, and crossed with otherwise adapted *O. sativa* cultivars. The initial generations of selection will be done using molecular markers in the laboratory. This has several advantages, such as not needing to grow all of the plants under stress conditions, and not having to grow plants that do not have the desired gene(s) to maturity (DNA can be taken from seedlings, and only those plants with the gene need be grown through to seed-set).

AfricaRice will thus develop the material ready for field testing; it will also carry out initial phenotyping of this material, and make initial QTL identifications. Meanwhile, Cornell, IRRI and NIAS will be carrying out the genomics and much of the molecular biology, identifying the genes and suitable markers.

"In just a few years, we should have so-called 'elite' germplasm ready for release," says Venuprasad. "What we are aiming for is a whole batch of ARICA varieties tolerant to drought and iron toxicity, and able to germinate under anaerobic conditions before the end of the decade. The first fruits of the STRASA project[4] give us hope that this can be achieved."

3. By the end of 2014, two varieties introgressed with the *Sub1* gene were available and ready for release in at least two countries.

4. *See above and* 'Naming of second batch of ARICAs' (page 51).

New breeding strategy

"In 2015, AfricaRice will adopt a new breeding strategy," says Kumashiro. "In most respects, it is the same as what we have been introducing over the past 5 years. Differences are to force us to use a method of generation advancement and centralized phenotyping (including MAS) in the early generations." This strategy will include the genetic gain requirements of the Gates Foundation as one of its elements.

"The support by the Bill & Melinda Gates Foundation for our breeding work has been phenomenal and essential," says Wopereis. "With the equally generous support from the Government of Japan it has funded the backbone of our rice breeding program since 2007. The STRASA and GSR projects conducted jointly by IRRI and AfricaRice and many other partners formed a rock-solid basis for the establishment of the Global Rice Science Partnership (GRiSP), the first CGIAR Research Program to be launched in early 2011, coordinated globally by IRRI, and in Africa by AfricaRice.[5] I am personally extremely proud of the RAM project, the first rice breeding project funded by the Gates Foundation that is led by AfricaRice. That project will allow us to have a close look at the 2000 *O. glaberrima* accessions in our genebank. I am certain that they harbor many unknown treasures of agronomic importance not only to Africa but to the entire rice-growing world."

5. Other architects of GRiSP are a third CGIAR center, International Center for Tropical Agriculture (CIAT), Japan International Research Center for Agricultural Sciences (JIRCAS), Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) and Institut de recherche pour le développement (IRD) in France.

Blaise Waly Basse

Blaise Waly Basse successfully defended his thesis, 'Impact of the adoption of the Sahel improved rice varieties on poverty in Senegal: Marginal treatment effect approach', and will be awarded his PhD by Gaston Berger University, Saint-Louis, Senegal, in January 2015.

Basse was selected by Institut sénégalais de recherches agricoles (ISRA) in Saint-Louis to help alleviate a human-resources constraint at ISRA at a time when there were many joint AfricaRice–ISRA projects and the ISRA rice economist and long-term collaborator with AfricaRice, Amadou Abdoulaye Fall, had been made head of the ISRA Saint-Louis station. A primary driver of Basse's work, both prior to and including his PhD research, was that despite its drive toward self-sufficiency in rice, Senegal continues to rely on imports (over 700,000 tonnes in 2011) to meet domestic demand for rice.

His pre-PhD research included a baseline survey of Senegal rice production, especially harvest and postharvest practices, including marketing. He also conducted a rice value-chain study in Guinea, evaluated risks in the Senegalese rice sector, and was part of a project to improve farmers' climate resilience in Nidayéne Pendao (Senegal River valley), as well as a project to assess the impact of the adoption of good agricultural practices by farmers in Dagana (also in the Senegal River valley).

Basse's PhD studies were jointly supported by AfricaRice and ISRA, supervised by Aliou Diagne, former leader of the AfricaRice Policy, Impact Assessment and Innovation Systems Program, and Amadou Abdoulaye Fall of ISRA; Basse was based at ISRA for the duration of his PhD research. His research looked at the value of the adoption of the 'Sahel' improved rice varieties promoted by AfricaRice and ISRA. The Sahel varieties — notably Sahel 108, Sahel 201 and Sahel 202 — were identified by AfricaRice and released in Senegal in 1994, particularly in the Senegal

River valley. Though adoption levels were initially below 10%, these varieties (plus later additions to the 'family', Sahel 134, Sahel 159, Sahel 208, Sahel 209 and Sahel 210, all released in 2007) have now been adopted by 51% of all rice farmers in Senegal and 93% of irrigated-rice farmers. Though the adoption level seems very high for varieties designed for the irrigated environment, they are in fact significantly lower than the potential 88% of all rice farmers and 95% of irrigated-rice farmers. Moreover, the Sahel varieties have demonstrated wide adaptability in the field, having been adopted in rainfed lowland cultivation in areas such as Casamance and Fatick (southwestern Senegal, north of The Gambia).

Basse used data for 1451 Senegalese rice farmers taken from a 2009 survey conducted by ISRA, DAPS, AfricaRice and Japan International Cooperation Agency (JICA). Consequently, the data were from all rice-growing regions of Senegal (except the Kaolack region). In particular, data from a women farmer group in Niona (rainfed lowland) were specifically included. From the complete survey, Basse selected farmers for his study by using two-stage random sampling. He then

used the marginal treatment effect (MTE) approach to determine the impact of the adoption of Sahel varieties on poverty. "The results indicate that the adoption of Sahel varieties has a positive and significant impact on rice yield, the overall income of rice farmers and poverty status," says Basse. "It is therefore possible to reduce poverty in Senegal through the adoption of Sahel varieties. Financial rate of return (80.9%) and the economic rate of return (72.1%) also indicate that rice breeding research in Senegal is financially and economically viable."

Basse observed that the farmers in the Senegal River valley were likely to take any seed available and that this was having a negative effect on yield, because of the uncontrolled quality of the seed. He therefore concludes that ISRA and the extension services in Senegal (notably Société d'Aménagement et d'Exploitation des terres du Delta et des vallées du fleuve Sénégal et de la Falémé [SAED]) should continue to promote use of Certified Seed of the Sahel varieties to obtain yields closer to the varieties' potential levels and thereby have a greater impact on poverty. This could be achieved by encouraging the formation of farmer groups, as they in turn tend to encourage adoption.

"In summary, it can be said that [in the Sahel varieties] Senegal has an instrument to reduce its dependence on imports," says Basse. "Increasing the income of rice farmers is an important component in the fight against poverty."

Confidence Duku

Ghanaian Confidence Duku was a research assistant at AfricaRice from 2011 to 2012, specializing in geographic information systems (GIS) and environmental modeling. Here, he was well placed to apply for and obtain a PhD scholarship in 2012 through the second phase of the 'Realizing the agricultural potential of inland valley lowlands in sub-Saharan Africa while maintaining their environmental services' (RAP) project, funded by the European Union (*see* 'Donor profile: European Union — Good things for inland valleys', *AfricaRice Annual Report 2012*, pages 32–34, for more information on RAP). His thesis title is: 'Towards food and water security: Modelling the spatiotemporal dynamics and accounting for hydrological ecosystem services'.

The PhD research program is with the Environmental Systems Analysis research group of Wageningen University. The work is supervised by Professor Lars Hein at the university and AfricaRice scientist Sander Zwart.

Confidence Duku (right) in the field during his tour of the upper Ouémé watershed

Ecosystem services are often marginalized in decision-making — undervalued and underappreciated mainly because these contributions to human welfare have not been explicitly evaluated. Moreover, the lack of ecosystem service assessment in sub-Saharan Africa at national and sub-national scales has resulted in the adoption of inappropriate measures that fail to include the role of the environment in poverty reduction. Duku's research is one such assessment.

Duku is looking at the rather large upper catchment area of the Ouémé River in north-central Benin, an area of over 14,000 km^2! Obviously, to cover such a vast area one is not looking at expansive fieldwork; however, Duku gladly admits, "I did go on a tour to all the major towns and agricultural areas in the study area."

Because of the low population density of the region (28 inhabitants/km^2) and agriculturally favorable climate conditions, the population of the upper Ouémé catchment is growing rapidly (4% per year), mainly as a consequence of agricultural colonization by migrants from other parts of Benin and neighboring countries. This rapid population growth has led to the expansion of agricultural areas and consequently deforestation and shortages of land immediately available for agricultural production.

The first aspect of Duku's research was to quantify the study area's hydrological services both spatially and over time, and to generate digital maps. This brought up a major methodological issue: could hydrological ecosystem services be integrated into ecosystem accounting (a comprehensive tool for environmental monitoring and management that aims to integrate the concept of ecosystems services, i.e. the contribution of ecosystems to human welfare, in a national accounting context)?

The good news is that apparently it can, and Duku and co-authors have a paper on the methodology — verified with data from the upper Ouémé catchment (from the former German-funded IMPETUS project and the international observation service African Monsoon Multidisciplinary Analysis – Coupling the Tropical Atmosphere and the Hydrological Cycle [AMMA-CATCH]) — out for peer review.

"We successfully developed a spatially explicit modeling approach, which distinguishes between service capacity and service flow, to map and quantify hydrological ecosystem services and used them to set up ecosystem accounts," says Duku. "The services we model and account for are crop water supply, household (ground and surface) water supply, water purification, and soil erosion control."

The second part of the study was to model the potential effects of deforestation on water availability. "Fifty-five percent of the study area is forest, and that forest regulates water flow, augmenting groundwater supply, especially in the dry season," says Duku. Over 90% of the region's population is dependent on groundwater for drinking and other uses. "Irrigation of crops with groundwater in the dry season will be dependent on the forest cover. But forest is being cleared to open up more agricultural land. Therefore, we need to know what level of deforestation will have a direct impact on farming, especially dry-season irrigated crops. Using the maximum water requirements for the major crops in the study area (including cassava, maize, millet, rice, yam), the model determined that it takes 6 ha of forest to ensure enough groundwater recharge to irrigate 1 ha of crops in the dry season. This is in addition to the water required for domestic use."

In addition to the effect of local changes on service provision, Duku will look at the risks that climate change poses on the capacity of the watershed to supply these services and the consequent likely effects on local livelihoods. "The supply of hydrological ecosystem services underpins food and water security," says Duku. "We will assess the reliability and resilience of the watershed to supply these services in a changing climate." With climate change, some areas that were not previously vulnerable to, say, drought will become vulnerable to it. Duku will map these vulnerable areas.

"Confidence Duku is one of my most promising PhD students; he has a real talent for integrating different disciplines in an integrated, sophisticated modeling approach," says Prof. Hein. "His work is addressing one of the key challenges in the field of developing ecosystem accounting approaches, in particular how hydrological services and their linkages to other ecosystem services can be included in this ecosystem accounting framework."

"Duku's work is immensely valuable to AfricaRice," says Zwart, "providing a tool that allows us to analyze the potential for development of rice systems and the sustainability of interventions, while making as little impact as possible on other users of water resources. There are challenges to applying these models in data-scarce regions and linking them to the socioeconomic aspects that determine potentials for development, but the RAP project in general and Duku's work in particular have made a good start in doing that."

Abraham Attah Shaibu

In 2009 to 2010, Abraham Shaibu was a research assistant at the AfricaRice Nigeria station for the 'Famine fund emergency rice' project funded by the United States Agency for International Development (USAID), which helped to boost rice production in Ghana, Mali, Nigeria and Senegal. In 2011, he then became a rice breeder at the National Cereals Research Institute (NCRI) in Badeggi, Niger State, Nigeria, where he assisted in the coordination of breeding task force trials, 'Stress tolerant rice for Africa and South Asia' (STRASA) and 'Green super rice' (GSR) projects in Nigeria (*see* 'Donor profile: Bill & Melinda Gates Foundation', pages 35–44, for further details on STRASA and GSR). In November 2012, Shaibu began his PhD studies on 'Assessment of the utility of *Oryza glaberrima* in breeding for drought tolerance in rice', funded by the Generation Challenge Program (GCP) of CGIAR. The research work is being co-supervised by Prof. M.I. Uguru of the Department of Crop Science, University of Nigeria, Nsukka, and AfricaRice lowland breeder Ramaiah Venuprasad, based at Ibadan.

"The upland NERICA varieties are known for their good drought tolerance, and that — in part — came from the *O. glaberrima* parents," says Venuprasad. "But the drought status of *O. glaberrima* accessions under lowland conditions was not known. Shaibu was the first to study the level of drought tolerance in these accessions using a modern protocol in comparison with current drought-tolerant breeding material and checks."

Shaibu screened about 2000 lines of *O. glaberrima* from the AfricaRice genebank and about 1755 interspecific breeding lines (*O. glaberrima* × *O. sativa*) from AfricaRice and the International Rice Research Institute (IRRI) for drought tolerance. Screening followed well-defined protocols at the Nigeria station

Abraham Shaibu identifying best donor parents in the initial stages of his research

in Ibadan, at a drought hot spot in Badeggi and in a rain-out shelter on the AfricaRice station in Cotonou, Benin. Shaibu identified 10 accessions of *O. glaberrima* with good tolerance to moderate drought over sites and seasons, and about 30 'good' interspecific lines.

The next stage of the work was to initiate crosses between the drought-tolerant germplasm identified (*O. glaberrima* accessions) and released rice varieties (*O. sativa*). Shaibu made 28 such crosses, from which three new interspecific breeding populations were developed, which were duly assessed for drought tolerance in the fourth generation (F_4). Meanwhile, the 30 drought-tolerant accessions are being further characterized for use in breeding.

In June 2015, Shaibu received a Fellowship Award from the Nestlé Research Center, Lausanne, Switzerland, as best young scientist for his research poster 'Screening African rice species (*Oryza glaberrima*) for breeding drought tolerance in rice with improved grain yield in lowland ecosystems in Africa', presented at the Nestlé Conference on Planting Seeds for the Future of Food, Lausanne.

"Thanks to Shaibu we now know how good the various *O. glaberrima* accessions really are in terms of drought tolerance, and which have potential value in breeding," says Venuprasad. "I appreciate Shaibu's work attitude. As what some would call a 'mature student', he is committed, hard working and sincere. I believe he is a man of integrity."

Although Shaibu aims to defend his thesis in 2015 with the results obtained, there is clear evidence that the breeding work is enormous and will be continued under new students. However, some material at F_5 generation is ready for wide-scale testing in the 2015 wet season.

"Almost 70% of the total rice area in Africa is rainfed, and drought is an important production constraint caused by the unpredictable and erratic rainfall pattern in the African region," says Shaibu. "New breeding lines have been developed, and the results obtained from my study are promising for rice farmers in Africa and for further breeding work. In particular, the interspecific lines have opened a new gene pool for rice improvement."

February

MICCORDEA final workshop

An end-of-project workshop was held in Dar es Salaam, Tanzania, 17–18 February for the 'Mitigating the impact of climate change on rice disease resistance in East Africa' (MICCORDEA) project. MICCORDEA was supported for 4 years by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and ran from 2010 to 2013 in Rwanda, Tanzania and Uganda.

There were 17 participants in the workshop, including one PhD and six MSc students supported by the project. For more detail on the project, *see* 'Climate-proofing East Africa's rice sector' (pages 26–29).

AfricaRice Science Week and GRiSP-Africa Science Forum

The annual Science Week and GRiSP-Africa Science Forum were held at AfricaRice temporary headquarters in Cotonou, Benin, 24–28 February.

Nearly 250 international and national rice research and development partners from the public and private sectors, including representatives of national research and extension programs of 28 African countries, met to discuss roadmaps and joint action plans for large-scale development impact in Africa.

"We have adopted a new format this year for our annual research meeting to allow improved planning of collaborative activities with our partners," said Marco Wopereis, AfricaRice deputy director general. "This will ensure that rice research products can be delivered as rapidly as possible into the hands of those who need them most — smallholder farmers — along with other stakeholders in the rice value chain such as millers, processors and rice consumers. Our annual Science Week is always cooperative and productive. It is rewarding to get so many good people together in the knowledge that we're all striving toward the same goals. It generates energy, enthusiasm and ideas, and renews our collective commitment to make things happen."

STRASA III Africa planning workshop

A planning workshop was held for the Africa component of the third phase of the project 'Stress tolerant rice for poor farmers in Africa and South Asia' (STRASA) in Cotonou on 28 February to 1 March. STRASA is supported by the Bill & Melinda Gates Foundation and executed by AfricaRice and the International Rice Research Institute (IRRI) in collaboration with national agricultural research systems (NARS) partners. (*See* 'Donor profile: Bill & Melinda Gates Foundation — Increasing rice yield under abiotic stress', pages 35–39, for more details about the STRASA project.)

March

ECOWAS regional rice offensive task force

The ECOWAS regional rice offensive for sustainable recovery aims to support the rice production dynamics started in 2008 with a view to achieving self-sufficiency in the region by 2025. A feasibility study of the program was entrusted to a technical task force comprising the Economic Community of West African States (ECOWAS), Hub Rural, AfricaRice, the International Food Policy Research Institute (IFPRI) and Laboratoire d'Analyse Régionale et d'Expertise Sociale (LARES). The task force met in Cotonou in March.

The program is designed for the period 2015–2025, and the budget for the first 5 years is estimated at US$ 404 million. The estimation by the task force shows that the region may start to attain rice self-sufficiency by 2023. The rice self-sufficiency ratio will range between 87% and 99% between 2015 and 2022. By 2023, production of over 26 million tonnes (Mt) of white rice should more than double the level of 2015.

Projections confirm the importance of promoting local and regional markets via which surplus rice production released by some major rice-producing basins can cover the deficits of other production areas. The estimation shows that per-capita consumption will be around 54 kg for an aggregate demand between 24 and 26 Mt of milled rice in 2025. Achieving self-sufficiency could improve the trade balance in rice, boost regional economic growth by approximately 0.5%, and contribute to the creation of over 8 million jobs in 2025. The cumulative job creation would be more than 36.5 million over the period 2015–2025, that is 20.7 million in the agricultural sector and 15.8 million in non-agricultural sectors.

Naming of second batch of ARICAs

The annual meeting of the Africa-wide Rice Breeding Task Force was held in early 2014, some time before postharvest testing of the season's candidate varieties was complete. However, the STRASA project had produced a number of selections and uses the same methodology as the task force ARICA scheme (*see* 'Research in brief — First fruits of the Africa-wide Rice Breeding Task Force: ARICA', *AfricaRice Annual Report 2013*, pages 32–37). AfricaRice biometrician Ibnou Dieng and his team trawled the global database for data on 77 'good lines' identified in STRASA and shortlisted 6 that met the criteria for ARICA nomination. These were approved by the task force on 14 March:

- **ARICA6** for rainfed lowland agro-ecosystems is tolerant of iron toxicity; it has already been released in Guinea and identified for release in Ghana.
- **ARICA7** for both rainfed and irrigated lowlands is tolerant of both iron toxicity and cold; it has been identified for release in Ghana and Senegal.
- **ARICA8** also for both rainfed and irrigated lowlands is tolerant of iron toxicity; it has already been released in Burkina Faso and has been identified for release in Guinea.
- **ARICA9** and **ARICA10** also for both rainfed and irrigated lowlands are both cold tolerant; and have both been identified for release in Mali.
- **ARICA11** for mangrove agro-ecosystems is salt tolerant; it has been released in The Gambia.

SARD-SC steering committee

Members of the Project Steering Committee (PSC) of the 'Multinational CGIAR support to agricultural research for development on strategic commodities in Africa' (SARD-SC) converged at the AfricaRice temporary headquarters in Cotonou for its annual meeting on 17 March. Participants were leaders from CGIAR Centers, IITA, AfricaRice, ICARDA and IFPRI, and a few from the private sector. The objective of the meeting was to give an overview and implementation update of the SARD-SC project, and discuss emerging challenges and issues. Decisions were made in relation to budgeting, gender, students (MSc and PhD) and monitoring and evaluation (M&E) issues.

CGIAR Consortium Board meeting

AfricaRice interim director general Adama Traoré participated in the CGIAR Consortium Board members and Center directors meeting hosted by the International Institute of Tropical Agriculture (IITA) in Dar es Salaam, Tanzania, 19–20 March. The meeting provided an opportunity to showcase the work that the Centers and CGIAR Research Programs are conducting and achieving in East and Southern Africa.

"The agricultural sector is crucial today, more than ever before, particularly in the face of climate change and the increasing global population. People who are already vulnerable and food insecure are already being affected by our changing climate. The CGIAR Research Programs are large-scale strategic programs put in place to deal with the cross-cutting nature of these challenges," said Frank Rijsberman, chief executive officer of the CGIAR Consortium. "Sub-

Saharan Africa is one of the most vulnerable regions, where a majority of the population are smallholder farmers who frequently face food insecurity and poverty."

35th annual full Board meeting

The AfricaRice Board of Trustees met for its annual meeting in Cotonou on 25–27 March. The business of the Board included approval of the *Center Development Plan 2014–2020,* which will see the Center strengthen its decentralized mode of operation and relocate its headquarters back to Côte d'Ivoire.

"For AfricaRice, the period has been one of growth and landmark achievements," Board chair Peter Matlon said at the end of the meeting. "We are also very grateful to all our donors and partners for their continued support and commitment to improving the lives of resource-poor rice farmers in Africa."

2014 AfricaRice Dr Robert Carsky Award

The AfricaRice Dr Robert Carsky Award was instituted in honor of the late Dr Robert Carsky, who lost his life while on duty in 2004. It is presented to staff in the internationally recruited (IRS) and general service (GSS) categories who have excelled in their sphere of work and made exceptional contributions to the Center and its mission.

On 27 March 2014, the award was presented to AfricaRice head of finance George Maina (IRS) and to bilingual secretary Lucie Dalie (GSS) for their contributions to the smooth functioning of the Center.

(Left to right) Peter Matlon, AfricaRice Board chair; Lucie Dalie, AfricaRice bilingual secretary; Rebecca Khelseau-Carsky; George Maina, AfricaRice head of finance; and Adama Traore, AfricaRice interim director general

April

Crop Science Society of Japan award

Drs Koichi Futakuchi, Moussa Sié and Kazuki Saito received the Best Paper Award in 2014 from the Crop Science Society of Japan for their paper 'Yield potential and physiological and morphological characteristics related to yield performance in *Oryza glaberrima* Steud.' published in *Plant Production Science* in 2012.

New project launch: Rapid mobilization of alleles for rice cultivar improvement in sub-Saharan Africa

A new project — 'Rapid mobilization of alleles for rice cultivar improvement in sub-Saharan Africa' (RAM) — was launched at a workshop in Ibadan, Nigeria, on 10–12 April. The project is being funded

(Left to right) Sié Moussa, Koichi Futakuchi and Kazuki Saito with their award for Best Paper from the Crop Science Society of Japan

for 5 years by the Bill & Melinda Gates Foundation and seeks to fast-track gene identification in *Oryza glaberrima* and rapid transfer into *O. sativa*-based varieties, especially for drought and flooding tolerance and tolerance of soil-related stresses (e.g. iron toxicity). (*See* 'Donor profile: Bill & Melinda Gates Foundation — Harnessing abiotic stress tolerance from African rice', pages 42–43, for more details.)

Senegal Minister of Agriculture visits AfricaRice Sahel station

A high-level delegation led by HE Papa Abdoulaye Seck, Senegal Minister of Agriculture and Rural Equipment, accompanied by the assistant to the governor of Saint-Louis region, in charge of development, Babacar Bâ, and regional director of rural development (DRDR) Tacko Diawara Ndao, visited Sahel station in Saint-Louis on 14 April. HE Papa Seck is a former director general of AfricaRice.

The visit formed part of the minister's meetings in Saint-Louis region to talk with rice farmers and scientists about the government's new 'Accelerated program for agriculture in Senegal' (PRACAS).

HE Papa Seck, Senegal Minister of Agriculture and Rural Equipment (center), flanked by Babacar Bâ, assistant to the governor of Saint-Louis (left), and Vincent Bado, AfricaRice regional representative in Senegal (right)

Université d'Abomey-Calavi's Science & Technology Week

From 15 to 18 April, the Université d'Abomey-Calavi (UAC) held its second Science & Technology Week, under the theme 'Challenges and opportunities of the scientific and technological revolution for progress'. The event was organized to present the technological progress achieved by UAC and its partners and to

Scenes from the second UAC Science & Technology Week

strengthen collaboration in science and technology. AfricaRice took part in the exhibition, showcasing seeds of improved varieties (e.g. the ARICAs, the NERICAs and the Sahel series developed by AfricaRice and its partners) in addition to posters and publication CDs relating to rice research and development (R&D).

Training workshop on experimental auctions for NARS scientists in Tanzania

The rice value-chain team at AfricaRice Cotonou, Dar es Salaam and Saint-Louis organized and hosted a 'Training workshop on experimental auctions' for national scientists from seven African countries, with support from AfDB, 21–25 April, in Dar es Salaam, Tanzania.

AfricaRice has used experimental auctions as an important research tool to find out consumers' perceptions of different types of rice and the price they would be willing to pay for them. The training course was intended to contribute to building the capacity of partners from SARD-SC project countries in the theory and practice of conducting experimental auctions.

Canada project technical meeting

The Canada-funded 'Support to rice research in Africa' held a technical meeting at Cotonou on 22–26 April. The food-security project focuses on postharvest handling, marketing and developing new rice-based products. (For more information on the project, *see* pages 00–00 *under* 'November'.)

Improving food security information in Africa

The technical workshop of the Japan-funded 'Improving food security information in Africa' project was held from 29 April to 2 May in Cotonou. The project, which was launched in 2013, seeks to improve food security and reduce poverty in sub-Saharan Africa by improving the availability and reliability of rice production statistics in support of the objectives of the Coalition for African Rice Development (CARD) initiative.

Representatives from 20 countries participated in the technical workshop. Yasuhiro Miyake, Deputy Director, Statistics Planning Division, Statistics Department of the Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan also attended.

May

Biotic stress, climate change and agricultural production

From 5 to 7 May, researchers from the International Institute of Tropical Agriculture (IITA), AfricaRice and Institut national de recherches agricoles du Bénin (INRAB) organized a meeting in Cotonou on 'Biotic stresses, climate change and agricultural production'. The major objective of the conference was to establish a research center of excellence on climate change and biotic problems at the IITA regional station in Cotonou, which is currently serving as the temporary headquarters of AfricaRice.

"This is also our contribution to a good transition strategy of AfricaRice HQ from Benin as recommended by the Board and the Council of Ministers," said Adama Traore, AfricaRice interim director general.

Genebank review

The CGIAR Research Program for Managing and Sustaining Crop Collections (Genebanks CRP) is coordinated by the Crop Trust, which commissioned a review of the AfricaRice genebank managed by its Genetic Resources Unit (GRU) from 5 to 8 May. The review panel comprised Johannes Engels (Chair), a genetic resources specialist retired from Bioversity International, and Chikelu Mba, in the seeds and plant genetic resources team of the Plant Production

and Protection Division of the Food and Agriculture Organization of the United Nations (FAO). The panel was accompanied by Genebanks CRP coordinator Charlotte Lusty, and facilitator and Crop Trust finance assistant Amanda Dobson. Ms Dobson worked with AfricaRice financial staff to review the financial support of the Trust to AfricaRice.

Overall, the impressions of the review team were positive, and recommendations were formulated that are being implemented by AfricaRice.

External review of Policy, Innovation Systems and Impact Assessment Program

A Center-commissioned external review (CCER) of the Policy, Innovation Systems and Impact Assessment Program was conducted from 26 May to 6 June. The review panel comprised Dunstan Spencer, consultant and CCER chair, who focused on policy and value-chain research; Nathalie M. Me-Nsope, gender lead/agricultural economist, Global Center for Food Systems Innovation, USAID-HESN Lab, Michigan State University, who focused on gender research; and Timothy Dalton, director and associate professor, Kansas State University, who focused on M&E and impact assessment. Panel members visited and interacted with AfricaRice staff and partners in Benin, Nigeria, Senegal and Uganda. Their report was presented during the September 2014 AfricaRice Board meeting by the CCER chair, via video link.

Overall, the social-science research was found to be effective, relevant and efficient. The view of the Panel was that "the Program is well structured and is fulfilling its mandate well." Recommendations were made to further enhance the performance of the program.

Country-led seed distribution ceremonies of Japan-funded Emergency Rice Initiative

The Emergency Rice Initiative aims to boost rice production in 2014 and beyond by improving farmer access to quality seeds and reducing postharvest losses in 27 sub-Saharan African countries, thereby reducing rice imports and averting the need for costly food-relief activities.

As part of the project, quality seed is produced and disseminated to vulnerable rice farmers by collaborating partners, in particular farmer organizations, extension agencies and NGOs. Seed distribution ceremonies with representatives from government authorities, national programs, Japanese embassies and AfricaRice are organized in the project countries.

Interim director general Adama Traoré participated in the seed distribution ceremony held in a village in Glazoué, Benin, on 30 May. Idrissou Adam Yacoubou Touré, cabinet director of the Ministry of Agriculture in Benin; HE Daini Tsukahara, Japanese Ambassador in Benin; and David Arodokoun, director general of Institut national de recherches agricoles du Bénin (INRAB) also participated in the ceremony, along with representatives from the national rice program, local authorities and rice farmer organizations.

Sixty tonnes of certified seed produced by INRAB and its partners were distributed to 2400 vulnerable farmers identified in four communes. Representatives from these farmers thanked the project after receiving the seed at the official ceremony.

June

WECARD/CORAF Fourth Agriculture Science Week

The West and Central African Council for Research and Development (WECARD/CORAF) held its fourth Agriculture Science Week in Naimey, Niger, 16–19 June.

During the week, AfricaRice interim director general Adama Traoré not only chaired major sessions but also received a special award for his distinguished services to agricultural science in Africa.

Interim director general Adama Traoré receives his award from the Governor of Niamey Region, M. Hamidou Garba Mamadou, at WECARD/CORAF's 4th Agriculture Science Week

Information and knowledge exchange facilitation workshop

AfricaRice organized a 3-day workshop and training event on 'Facilitating information and knowledge exchange in rice sector development' in Cotonou on 25–27 June. Thirteen African countries were represented by national experts in communication, ICT and knowledge management. These experts are working in the rice sector development hubs.

The objective of the workshop was to create a joint mechanism to (i) share information and knowledge related to scalable rice technologies and activities in the hubs in the most effective and efficient manner; and (ii) reach out to end-users of rice technologies and services, such as rice farmers, processors, agricultural machinery manufacturers and traders.

Participants discussed the use of video and rural radio to report on work with farming communities and to document scalable technologies. Rural radio will be used to guide the rice community throughout the cropping season, advising on crop management practices and sharing experiences among value-chain actors. Each country is expected to develop an action plan and 'rice knowledge management package' (combinations of video, rural radio, use of the Rice *e*Hub, printed material, billboards, etc.) that best fits their resources and priorities. Based on these country action plans, partners such as Farm Radio International and Digital Green will provide technical support to ensure the selected tools facilitate information and knowledge exchange with large numbers of end-users.

The event was organized with support from the Global Rice Science Program (GRiSP) and the AfDB-funded SARD-SC project.

July

National experts committee

The ninth biennial meeting of the National Experts Committee (NEC: directors general of the national agricultural research systems (NARS) of AfricaRice member states) was held in Saint-Louis, Senegal, from 2 to 4 July. Directors general of NARS of 17 countries participated, and there were representatives from WECARD/CORAF, Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), Network of Farmers' and Agricultural Producers' Organizations of West Africa (ROPPA) and the president of Fédération des groupements et associations des femmes productrices de la région Saint-Louis (FEPRODES, women farmers' association in Saint-Louis).

AfricaRice interim director general Adama Traoré gave an overview of the major developments since the last Council of Ministers in December 2013 and briefed the NEC on the recruitment process for the next director general. An update on the plans for the return of AfricaRice to Côte d'Ivoire was presented by the regional representative of Côte d'Ivoire.

The NEC expressed its appreciation for all the presentations and reports, and made 12 recommendations.

NEC members and other participants at their meeting went on a guided tour of the new AfricaRice Regional Training Center

A guided tour of the new Regional Training Center was organized for the NEC participants.

Another NERICA award!

The AfDB received the US Treasury Award for Development Impact for the 'NERICA dissemination project'. The project ran for 8 years from 2004 to 2011, and was operated under the auspices of the African Rice Initiative (ARI), itself launched in 2002. NERICA varieties were AfricaRice's flagship technology for boosting the rice-production sector, first in the uplands from the late 1990s and later in the lowlands.

Liberia office operational

Also in July, renovation of the AfricaRice Liberia office was completed, enabling AfricaRice projects coordinator for the country, Inoussa Akintayo, to finally have an office to call his own... albeit only briefly! (*See next item.*)

August

Ebola strikes! Evacuation of staff from Sierra Leone and Liberia

Just 2 months earlier (in early June), AfricaRice management had asked rice research coordinator in Sierra Leone, Bert Meertens, for a situation report on the Ebola epidemic that had broken out in Guinea, Liberia and Sierra Leone. At that very moment, AfricaRice internal auditor Serge Ebanga was running risk-management training at the Rokupr Research Station where the AfricaRice staff are based. Moreover, Rokupr was free of the disease. The epidemic was taken as a case study by the training participants, and it was deemed that the risk was 'not too high'. However, things then moved quickly, with the president of Sierra Leone declaring a state of emergency on 30 July. AfricaRice staff were ordered to evacuate to Cotonou for 2 weeks (!). It took 5 days for the team to be able to get onto a flight to Abidjan and then continue on to Cotonou. There can be few people

around the world who have access to the media who do not know what happened next. Ebola went exponential in the three countries at the center of the epidemic: by the end of the year, the World Health Organization estimated that there had been over 20,000 cases and fast approaching 10,000 deaths..

"It was not easy," says Meertens. "We left with just two suitcases each, leaving behind colleagues and belongings. Things developed very rapidly during the 5 days we had to prepare." AfricaRice staff were the 'lucky' ones!

Meanwhile, staff at AfricaRice temporary headquarters in Cotonou were monitoring the Ebola situation in Liberia from a distance. AfricaRice projects coordinator in Liberia, Inoussa Akintayo, takes up the story: "The situation was evaluated on a day-to-day basis from Cotonou. When the situation became serious, we were instructed to leave immediately, and tickets were sent to us." The first staff left on 4 August. "I was of course, as team leader, the last person to leave on 8 August," says Akintayo. "I flew to Accra and from Accra to Cotonou."

Ebola had devastating effects on Liberia's rice sector. Farmers abandoned their fields and even their villages, and many of them died from the disease. Restrictions on movement stopped farmers from working together. Markets were closed, so there was nowhere to buy inputs (e.g. seed, fertilizer) and nowhere to sell any rice produced; fresh produce simply rotted. Seed production plots were abandoned as a result of the AfricaRice evacuation, both at the research station and among outgrowers, as there was no one to monitor the production and support the farmers.

Subsequently, the Liberia staff relocated to the AfricaRice M'bé research station in Côte d'Ivoire with a very specific agenda: to produce seed ready to rehabilitate the rice sector in Guinea, Liberia and Sierra Leone post-Ebola; to continue breeding activities with material brought from Liberia; and to assist in regional seed mobilization.

Training of national partners in automation of data collection, analysis and impact assessment

In the framework of the AfricaRice Strategic Plan 2011–2020, baseline surveys are being carried out in 34 rice sector development hubs in 18 countries. In order to continue with the harmonization and automation of baseline surveys in the rice hubs, AfricaRice has been organizing a series of training courses for national partners on automation of impact and socioeconomics analysis. A training course for English-speaking countries was organized, 4–9 August, in Kigali, Rwanda, in which 17 NARS scientists representing 11 countries of the Africa-wide Rice Policy Task Force took part. This was followed by a training course for the French-speaking countries, which took place in Cotonou, 21–29 August.

September

Scalable rice technologies

The First Innovation Fair on Scalable Rice Technologies for Benin and Togo was held at AfricaRice in Cotonou on 1–2 September. Innovative R&D products, tools and approaches developed by AfricaRice and its partners to boost productivity in Africa's rice farming were showcased. The technologies on display included new climate-smart ARICA rice varieties; Smart-valleys, a low-cost participatory and sustainable approach to develop inland valleys in sub-Saharan Africa for rice-based systems (*see* 'Smart-valleys', pages 32–34); mechanical weeders; power tillers; an energy-efficient rice parboiler (GAM); and RiceAdvice, a decision-support app for providing farmers with field-specific resource management guidelines.

The main objectives of the Rice Innovations Fair were to raise awareness about the latest innovations and to identify, with development partners, donors and researchers, promising scalable technologies and define dissemination pathways.

Scenes from the first Rice Innovations Fair

CGIAR Development Dialogues

Top scientists, policy-makers and donor representatives gathered together at the high-level 'CGIAR Development Dialogues 2014' on 25 September in New York to draw global attention to the vital roles of agriculture, livestock, fisheries, landscapes and food systems in sustainable development. The event also urged global leaders to think more broadly about climate-smart agriculture. AfricaRice was well represented at this important event.

AfricaRice mobile app becomes 'App of the Week'

Infinite Monkeys made the AfricaRice app its 'App of the Week' for 28 September to 4 October.

Each week Infinite Monkeys selects one app from the thousands published with its free app-maker platform. The AfricaRice app was chosen as an example of the quality, beauty and usefulness that mobile apps can bring to a traditional community. The app has 16 links to social media and different content sections, and links to the user's Slideshare, podcast, video and photo gallery accounts. Users can also find relevant news about the latest technologies that could help rice farmers increase their production. Quick links to Facebook and Twitter are also included.

October

French embassy poster competition

AfricaRice research assistant Bachabi Fatima received a Scientific Poster award in the competition organized by the French Embassy in Benin, IRD and CIRAD. She was ranked sixth.

AfricaRice sets up shop in the home of the lemurs

AfricaRice has deployed two scientists to Madagascar: senior rice breeder Moussa Sié (transferred from Benin) and high-altitude rice breeder Negussie

Zenna (transferred from Tanzania). Sié is country coordinator, based at Centre National de Recherche Appliquée au Développement Rural (FOFIFA) headquarters in Antananarivo. Zenna is sharing an office with the upland rice breeders of FOFIFA and Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) at the FOFIFA station in Antsirabe.

Madagascar is the second largest rice producer in Africa (after Nigeria). Everywhere you look there is rice — lowland, irrigated, upland, high elevation. AfricaRice is providing backstopping and training to FOFIFA. For the first year, AfricaRice is concentrating on the medium- and high-elevation areas, particularly the Amoubary–Ivory hub, which covers both 'lowland' and upland rice. A particular focus is on red forms of *Oryza glaberrima*, with a drive to evaluate all red-rice landraces available in the genebank and the hubs. There will also be participatory varietal selection (PVS) activities in the hubs, especially with red-rice farmers, and Sié will be shuttle breeding between West Africa and Madagascar. "Madagascar forms a bridge between Africa and Asia," says Sié. "It has a rich genebank that is not well maintained or used."

FAO delegation visits AfricaRice

FAO assistant director-general and regional representative for Africa Bukar Tijani visited AfricaRice temporary headquarters in Cotonou on 22 October. After detailed discussions and presentations, Mr Tijani was taken on a tour of the facilities, including the fields and postharvest workshop.

FAO is seeking to build a broad partnership with governments, the private sector, research institutions, producer organizations and donors to develop an efficient, productive and sustainable rice-growing sector in the continent.

"AfricaRice will be a key partner in this initiative, as recommended by African ministers of agriculture and other partners," said Tijani. "We believe that any change in Africa's rice sector will begin with innovation from AfricaRice."

FAO assistant director-general and regional representative for Africa Bukar Tijani (second from left) with (left to right) AfricaRice Genetic Diversity and Improvement Program leader Takashi Kumashiro, AfricaRice interim director general Adama Traoré, and FAO representative in Benin Yo Tiémoko

AfricaRice grain quality specialist John Manful (left) describes the briquette-making process to a visitor to the AfricaRice booth at the Fourth International Rice Congress

Fourth International Rice Congress

AfricaRice was well represented at the Fourth International Rice Congress in Bangkok, Thailand, from 27 October to 1 November.

AfricaRice scientist Gaudiose Mujawamariya and research assistant Esther Leah Achandi received the Young Rice Scientists Award.

November

Rice diseases workshop

From 24 to 26 November, AfricaRice, CIRAD and IRD co-organized a workshop on rice diseases, 'Improving epidemiology and disease diagnosis for sustainable management', in Montpellier, France. The workshop was funded by GRiSP and (a) initiated the development of robust, cost-effective and transportable epidemiological surveys and diagnosis protocols; (b) designed the framework of an international network of rice pathologists taking into consideration continental/regional specificities (mainly targeting Africa); and (c) established the African Network of Rice Pathologists. The workshop provided an opportunity to review the results and progress of the current GRiSP project on 'Methodologies and new resources for genotyping and phenotyping of African rice species and their pathogens for developing strategic disease resistance breeding programs' (MENERGEP).

Discussions focused mainly on: standardized protocols for diagnosis, genotyping and phenotyping of the main rice diseases; pathogen isolate collections: rules, management and backup strategies; pathogen epidemiological surveys: a multi-pathogen approach and better connection with the Africa-wide Rice Breeding Task Force and rice sector development hubs in Africa; and emerging diseases: symptoms, distribution and diagnosis tools.

AfricaRice showcases improved seed, machinery and tools

AfricaRice showcased improved seed, machinery and tools, and interim director general Adama Traoré made a speech at the Second National Meeting of Small and Medium-sized Enterprises (SME/PME) of Benin held at the Palais des Congrès, Cotonou, 10–14 November. Participants showed keen interest in the range of rice technologies developed by AfricaRice and its partners with support from donors, particularly Canada's Department of Foreign Affairs, Trade and Development (DFATD), displayed at the exhibition. AfricaRice also fielded a panel of Dr Traoré, head of the grain quality unit John Manful and postdoctoral fellow Sali Atanga Ndindeng to respond to questions about rice production, quality and imports in Africa.

The AfricaRice panel at the Second National Meeting of Small and Medium-sized Enterprises, Cotonou, November

Celebrating FARA

A 'Celebrating FARA' event was held in Johannesburg, South Africa, from 26 to 28 November. As part of the CGIAR-led Agricultural Technology Fair, AfricaRice posters and publications were prominently displayed at the CGIAR booth. An AfricaRice delegation was led by interim director general Adama Traoré.

UEMOA 20th anniversary seminar at AfricaRice

The West African Economic and Monetary Union (UEMOA) resident representative in Senegal, Fatimata Sawadogo, gave a lecture at the AfricaRice training center in Saint-Louis, Senegal, on 28 November as part of UEMOA's 20th anniversary activities. Sawadogo presented UEMOA's current activities, its achievements and ongoing challenges. Both Institut sénégalais de recherches agricoles (ISRA) and Société d'Aménagement et d'Exploitation des terres du Delta et

des vallées du fleuve Sénégal et de la Faléme (SAED) were also represented at the seminar.

Mid-term review of the Canada-funded food security project

In November and December 2014, there was a mid-term review of the Canada-funded project 'Enhancing food security in Africa through the improvement of rice postharvest handling, marketing and the development of new rice-based products' commissioned by the donor. The review panel comprised M&E expert Ouadi Youssef and consultant Serge Eric. The review team members visited Benin, Cameroon and Senegal, meeting AfricaRice staff and partners (Institute of Agricultural Research for Development [IRAD] and ISRA). The project is also active in The Gambia, Ghana, Mali, Nigeria, Sierra Leone and Uganda.

Mid-term review panel for the Canada-funded project reviewing rice-based products with AfricaRice PDF Sali Ndindeng

The overall assessment of the project was positive concerning its relevance, and (to a fair extent) its governance approach, the progress made by partners in achieving most research results, and in adopting a gender-sensitive approach. However, the evaluation noted considerable room for improvement in a number of areas that limit the project's ability to fully realize its inherent potential, particularly in relation to knowledge sharing and dissemination. The reviewers suggested that the project should focus more on the dissemination of research results in the next step.

The review made a number of recommendations that are being implemented by AfricaRice, in particular:

- the design, planning and implementation of the extension activities should be as participatory as possible, involving key rice value-chain actors to ensure broad buy-in and ownership of the improved harvest and postharvest techniques;
- NARS should establish a system of regular contact with 'trained' persons to discover and address any issues that may cause them to stop being active as trainers.

December

New video

On 4 December, AfricaRice launched a new 11-minute video, *From harvest to plate: Adding value to Africa's rice*, based primarily on the Canada-funded food-security project (*see* 'November — Mid-term review of the Canada-funded food-security project', left and above).

Review of the Sustainable Productivity Enhancement Program

From 4 to 12 December, a CCER was held focusing on the Sustainable Productivity Enhancement Program. The review panel comprised: Andre Bationo, consultant based in Accra, Ghana, and CCER chair, who was focusing on soil fertility and general agronomy research; Anneke de Rouw, Institut de recherche pour le développement (IRD), Paris, France, who was focusing on weed research; and Cees van Diepen, Alterra, Wageningen, Netherlands, who was focusing on crop simulation modeling and remote sensing. Panel members talked to AfricaRice staff and partners in Benin, Senegal and Tanzania. The report will be presented at the March 2015 AfricaRice Board meeting by the CCER chair.

Statement of financial position

As at 31 December 2014

ASSETS	2014 (US$)	2013 (US$)
Current assets		
Cash and cash equivalent	8,513,696	13,914,637
Accounts receivable:		
Donors	9,069,407	8,265,287
Employees (net of allowances)	631,312	536,290
Accounts receivable – CGIAR Centers	806,347	679,085
Others (net of allowances)	1,046,954	206,639
Inventories	361,196	319,740
Prepaid expenses	1,273,907	664,368
Total current assets	**21,702,819**	**24,586,046**
Property and equipment		
Property and equipment	13,146,677	15,103,741
Less: Accumulated depreciation	(11,701,981)	(14,472,074)
Total property and equipment – Net	**1,444,696**	**631,667**
Total assets	**23,147,515**	**25,217,713**

LIABILITIES AND NET ASSETS	2014 (US$)	2013 (US$)
Current liabilities		
Bank balances (overdraft)	21	
Accounts payable:		
Donors	4,635,131	6,473,990
Employees	950,187	736,293
Accounts payable – CGIAR Centers	327,961	426,636
Others	468,122	556,356
Employees investment account		214,562
Provisions and accruals	3,606,940	3,694,520
Total current liabilities	**9,988,362**	**12,102,356**
TOTAL LIABILITIES	**9,988,362**	**12,102,356**
Net assets		
Unrestricted net assets:		
Undesignated	11,714,457	12,483,690
Designated	1,444,696	631,667
TOTAL NET ASSETS	**13,159,153**	**13,115,357**
TOTAL LIABILITIES & NET ASSETS	**23,147,515**	**25,217,713**

Statement of activity

For the year ended 31 December 2014

(Expressed in US$)

	2014				2013			
	Unrestricted	CRP	Non-CRP	Total	Unrestricted	CRPs	CRP	Total
Revenue and gains								
Grant revenue								
Window 1 & 2	—	10,198,151	0	10,198,151	—	9,484,716	—	9,484,716
Window 3	91,140	4,746,915	3,115,685	7,953,740	269,565	3,991,578	5,738,707	9,999,850
Bilateral	693,249	7,723,941	1,998,859	10,416,049	508,093	8,518,203	1,684,059	10,710,355
Total grant revenue	**784,389**	**22,669,007**	**5,114,544**	**28,567,940**	**777,658**	**21,994,498**	**7,422,766**	**30,194,921**
Other revenue and gains	707,099	—	—	707,099	622,850	—	—	622,850
Total revenue and gains	**1,491,488**	**22,669,007**	**5,114,544**	**29,275,039**	**1,400,508**	**21,994,498**	**7,422,766**	**30,817,772**
Expenses and losses								
Research expenses	1,014,703	17,307,740	3,224,396	21,546,839	12,007	16,179,643	3,197,722	19,389,373
CGIAR collaborator expenses	—	237,553	—	237,553	—	108,560	—	108,560
Non-CGIAR collaborator expenses	—	3,063,421	1,681,509	4,744,930	—	3,792,960	2,995,253	6,788,213
General and administration expenses	2,701,921	0	0	2,701,921	3,954,636	—	—	3,954,636
Indirect cost recovery	(2,268,932)	2,060,293	208,639	0	(3,143,125)	1,913,335	1,229,791	0
Other expenses and losses								
Total expenses and losses	**1,447,692**	**22,669,007**	**5,114,544**	**29,231,244**	**823,517**	**21,994,498**	**7,422,766**	**30,240,781**
Surplus (deficit)	**43,795**	**0**	**(0)**	**43,795**	**576,990**	**(0)**	**0**	**576,990**
Expenses by function								
Personnel costs	2,897,465	7,659,579	1,646,558	12,203,602	2,156,835	7,041,501	1,154,856	10,353,192
CGIAR collaboration costs		237,553	0	237,553		108,560		108,560
Other collaboration		3,063,421	1,681,509	4,744,930		3,792,960	2,995,253	6,788,213
Supplies and services	267,009	7,180,461	1,202,203	8,649,673	1,187,405	7,014,169	1,539,948	9,741,523
Travel	338,343	1,813,452	220,535	2,372,330	447,815	1,607,789	291,417	2,347,021
Depreciation	213,807	625,367	149,622	988,796	174,588	486,744	202,829	864,161
Cost-sharing percentage		28,880	5,478	34,358		29,440	8,673	38,113
Indirect cost recovery	(2,268,932)	2,060,293	208,639	0	(3,143,125)	1,913,335	1,229,791	0
Total operating expenses	**1,447,692**	**22,669,007**	**5,114,544**	**29,231,243**	**823,517**	**21,994,498**	**7,422,766**	**30,240,782**

Schedule of grant revenues

For the year ended 31 December 2014

(Expressed in US$)

Donor[1] and program/project	Grant period	Grant pledged (total)	2014 annual revenues	2013 annual revenues
UNRESTRICTED GRANTS				
Japan	Jan–Dec '14	91,140	91,140	269,565
Member states contributions	Jan–Dec '14	693,249	693,249	508,093
Sub-total unrestricted grant revenues		**784,389**	**784,389**	**777,658**
Window 1 and Window 2 (W1/W2) funding				
CGIAR Research Program (CRP) grants				
CCAFS CRP total	Jan–Dec '14	366,565	366,565	397,470
GRiSP CRP total	Jan–Dec '14	8,715,042	8,715,042	7,602,000
GRiSP – IRRI bilateral projects	Jan–Dec '14	679,775	679,775	1,161,563
Sub-total		**9,761,382**	**9,761,382**	**9,161,033**
CGIAR Genebank CRP funding				
Fund Council genebank	Jan–Dec '14	406,315	359,740	323,683
Fund Council genebank (DRC)	Jan '13–Dec '15	49,880	36,664	
Fund Council genebank (CAR)	Mar '13–Dec '15	48,720	40,365	
Sub-total CGIAR Genebank CRP fund grants		**504,915**	**436,769**	**323,683**
Sub-total W1 and W2 CGIAR CRP funding		**10,266,297**	**10,198,151**	**9,484,716**
Window 3 (W3) funding				
Gates Foundation – RAM for rice cultivar improvement	Nov '13–Dec '18	7,500,000	1,170,502	
EU – RAP project	Jan '11–Dec '14	3,187,903	1,108,169	905,947
EC-IFAD/CARD South–South collaboration	Aug '12–Sep '14	551,200	192,614	293,850
IFAD – WCA Phase 2	Mar '13–Mar '16	1,470,000	381,567	370,659
Japan/UNDP-TCDC – Interspecific Hybridization Project	Apr '14–Mar '15	210,000	105,351	411,954
Japan – Increasing quality project	Apr '14–Mar '15	68,800	19,063	68,668
Japan – Development of interspecific progenies project	Apr '14–Mar '15	60,200	19,595	83,922

1. Abbreviations are spelled out in the list that starts on page 102.

Donor[1] and program/project	Grant period	Grant pledged (total)	2014 annual revenues	2013 annual revenues
Japan – High yield varieties in humid zone project	Apr '14–Mar '15	60,200	34,360	102,852
Japan – Physiological & genetic investigation project	Apr '14–Mar '15	33,000	30,147	139,715
Japan – Development of sustainable rice farming systems project	Apr '14–Mar '15	17,000	17,502	82,059
Japan – Breeding project	Jan '10–Dec '14	8,000,000	1,602,800	1,424,041
Japan – Emergency project phase 2	Apr '13–Mar '15	9,000,000	3,081,293	5,738,707
Japan – RYMV project	Apr '14–Mar '15	60,200	65,246	107,911
USAID – Seed scaling project	Oct '14–Sep '15	1,960,000	34,392	
Sub-total W3 funding		**32,178,503**	**7,862,600**	**9,730,285**
BILATERAL FUNDING				
ANR – ESCAPE project	Jul '11–Nov '14	146,146	14,949	70,126
ACP – AfroWEEDS project	Oct '09–Oct '12	348,469	21	–39
BADEA – Rice production training	Nov–Dec '13	64,710	–10,142	74,852
CAAS – Green Super Rice phase II	Oct '12–Oct '15	1,300,000	439,410	589,050
Canada – Support to Rice Research in Africa	Apr '11–Mar '16	7,136,573	934,967	1,749,713
CFC – Central Africa rice project	Jan '08–Dec '12	2,309,560	2,106	–72,255
DFID – SCPRID project	Sep '13–Aug '17	387,303	119,143	86,937
EU – Rice policy (Incremental Fund)	Jun '10–Dec '13	2,700,222	60	174,614
Gatsby project	Jan–Dec '13	11,776		11,776
GCP – Rice Challenge Initiative	Jun '09–Nov '15	2,687,634	238,255	767,008
GCP – Integrated Breeding Platform support	Jan '14–Dec '15	120,000	71,946	
GCP – Rice Challenge Initiative extension	Dec '14–Nov '15	100,000	566	
GIZ – GlobE project	Jul '13–Jun '16	551,200	256,135	45,839
GIZ – CAUSA project	Oct '14–Dec '16	608,000		
GIZ – MICCORDEA	Jan '10–Dec '13	1,600,937		131,237
GIZ – Attributed grant	Jan–Dec '14	286,003	286,003	307,853
AIDP – Liberia	Oct '12–Jul '15	854,232	279,386	445,425
FTF – Ghana	Feb–Dec '12	292,783	253	–4,281
Africa Rising	Apr–Dec '12	170,000	–2,465	
AfDB – SARD-SC	May '12–Nov '16	15,500,500	2,784,219	1,919,598
AfricaRising – Tanzania project	Dec '14–Aug '15	300,000	16,692	
Gates Foundation – IRRI – STRASA phase 2	Mar '11–Feb '14	4,800,000		1,598,246

Donor[1] and program/project	Grant period	Grant pledged (total)	2014 annual revenues	2013 annual revenues
GRiSP/IRRI–USAID – University linkage fund	Jul '13–Dec '14	38,738	2,596	14,700
IRRI – STRASA phase III	Apr '14–Mar '19	8,000,000	1,616,128	
Japan – SMART-IV project	Oct '09–Sep '14	3,055,239	409,131	545,228
Japan – CGIAR Fellowship program (Abe)	Nov '10–Feb '11	12,700		5,807
Japan – CGIAR Fellowship (Michi)	Jan–Dec '12	7,192	6,420	
Japan – Statistics project	Oct '12–Mar '15	811,863	262,293	362,899
JIRCAS – Fellowship	Nov–Dec '12	51,560		665
Japan – SMART-IV phase 2	Oct '14–Sep '15	475,642	69,997	
Mali LABOSEM – Seed lab audit project	Jan '12–Dec '13	95,448	3,102	38,648
Nebraska University – GYGA project	Feb '12–Mar '14	102,350	20,199	71,114
Nigeria Federal Government – RTA project	Jan '13–Dec '15	1,666,170	587,555	848,133
IBRD–Sierra Leone government – WAAPP Sierra Leone	Mar '13–Feb '16	2,164,528	430,892	220,968
IBRD–Liberia government – WAAPP Liberia	Jul '13–Jun '16	1,540,112	408,992	3,746
CORAF/WECARD – WAAPP	May '13–Oct '14	50,000	33,140	
Nebraska University – GYGA project phase 2	Apr '14–Mar '15	75,000	69,613	
CORAF/WECARD – WAAPP	May '14–Oct '15	181,000	79,219	
Syngenta Foundation for Sustainable Agriculture (SFSA) – NRM evaluation	Mar '14–Oct '15	103,000	76,486	
UEMOA – PACER – Saint-Louis Center of Excellence project	Aug '12–Aug '14	301,205	180,322	127,139
UEMOA – PAU project	Jul '14–Jun '17	2,167,065		
WOTRO – Parasite project	Apr '11–Mar '15	139,923	23,207	44,419
GCP-NAM population – AfricaRice/CIAT	Aug '08–Dec '13	138,950		23,098
Fund Council Genebank (RIN)	Jan–Dec '14	12,010	12,006	
Sub-total bilateral funding		**63,465,742**	**9,722,800**	**10,202,263**
Total restricted grants		**105,910,542**	**27,783,551**	**29,417,263**
Total grant revenues		**106,694,931**	**28,567,940**	**30,194,921**

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(As at 31 December 2014)

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‡ Left in 2014.

Senior Staff and Associates

(As at 31 December 2014)

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Akram Akanni Abiodou Sadikou *	Senior Accountant
Farouck Adosso *	Financial Coordinator
Gbènakpon U. Christson Azondekon *	Senior Accountant – Grants
Awa Jarjusey ‡	Consultant

Human Resources Office

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Maimouna Gnougo Ouattara	Human Resources Coordinator
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Safiatou Yabré	Manager, Travel and Liaison
Gisèle Dago	Chargé d'accueil et de l'orientation / Welcome Officer

Operations and Facilities Unit

Klana Dagnogo	Head of Facilities and Operations
Mohamed Mouhidiny Abdou	Purchasing Specialist
Richelle Sandra Houngue *	Head of Procurement and Supplies
Maryana Yuno	Compliance Logistician

Information and Communications Technology Unit

Moussa Davou ‡	ICT Manager
Nadia Abbas Kazmi *	Information & Communications Technology Unit
Abdoulaye Sanwidi	Systems Analyst
Koffi Pascal Kpangui *	Electronics Engineer
René Christian Kacou *	Senior Systems Administrator / Deputy ICT Manager

Research Division

Olupomi Ajayi	Risk Management Coordinator / Project Coordination Support
Maïmouna Diatta	French Editor/Translator
Emmanuel Onasanya	Desktop Publishing Assistant
Fassouma Sanogo	Translator

Genetic Diversity and Improvement Program

Takashi Kumashiro	Program Leader
Kofi Isaac Bimpong	Molecular Geneticist – Salinity Tolerance (Senegal)
Ibnou Dieng	Biometrician
Khady Nani Dramé	Molecular Biologist (Tanzania)
Raafat El-Namaky	Hybrid Rice Breeder (Senegal)
Mamadou Fofana	Drought Physiologist (Ibadan)
Baboucarr Manneh	Irrigated Rice Breeder (Senegal)
Marie-Noëlle Ndjiondjop	Molecular Biologist, Head of Genetic Resources Unit
Saber El-Sayed Sedeek	Upland Rice Breeder (Tanzania)
Mandè Semon	Upland Rice Breeder (Ibadan)
Moussa Sié	Senior Rice Breeder, Rice Breeding Task Force Coordinator ‡ Country Representative (Madagascar) *
Drissa Silué	Plant Pathologist
Negussie Shoatec Zenna	High-altitude Rice Breeder (Tanzania, later Madagascar)
Ramaiah Venuprasad	Rainfed Lowland Rice Breeder (Ibadan)
Mounirou El Hassimi Sow	PDF Molecular Genetics

Yonnelle Dea Moukoumbi	PDF Yield Potential in Irrigated and Aerobic Growth Conditions (Senegal)
Honoré Kam *	PDF Abiotic Stress (Nigeria)
Sangeetha Kalimuthu Kannan	Programmer (Tanzania)
Oluwatoyin O. Afolabi	Research Assistant
Amakoé Délali Alognon	Research Assistant
Nana Kofi AbakaAmoah	Research Assistant (Senegal)
Cheikh Oumar Ly	Research Assistant Plant Breeding (Senegal)
Fatimata Bachabi	Research Assistant
Saidu Bah	Research Assistant
Popoola Bosede	Research Assistant (Ibadan)
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Daouda Mbodj	Research Assistant (Senegal)
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Dro Daniel Tia	Research Assistant
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Tiémoko Coulibaly *	Program Assistant STRASA/GSR (Senegal)

Sustainable Productivity Enhancement Program

Koichi Futakuchi	Program Leader and Crop Ecophysiologist
Senthilkumar Kalimuthu	Cropping Systems Agronomist (Tanzania)
John Manful	Grain Quality Specialist
Mutsa Masiyandima	Water Management Specialist (Senegal)
Jonne Rodenburg	Agronomist (Tanzania)
Kazuki Saito	Rice Agronomist
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Pepijn van Oort	Crop Modeler (Wageningen)
Sander Zwart	Remote Sensing and GIS Specialist
Mohamed Abd Salam El Vilaly *‡	Remote Sensing and GIS Specialist
Justin Djagba	Research Assistant GIS
Kodjo Soklou A. Worou	Consultant
Alpha Bocar Balde	PDF Climate Risk Assessment (Senegal)
Mamadou Cissoko	PDF Weed Science (Field Fellow, Tanzania)
Sali Atanga Ndindeng	PDF Grain Quality and Postharvest Technology

Atsuko Tanaka	PDF Soil Science
Elke Vandamme ‡	PDF Agronomist (Field Fellow, Tanzania)
Koffi Djaman *	PDF Agronomist (Field Fellow, Senegal)
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Abou Togola	Research Associate, Entomology (Ibadan)
Amadou Touré	Research Associate, Agronomy
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Kokou Ahouanton	Research Assistant
Daniel Damson Elifadhili	Research Assistant (Tanzania)
Seth Graham Acquaah	Research Assistant
Y. Jean-Martial Johnson	Research Assistant
Yaha Perpetue Kouamé	Research Assistant
Derek Makokha	Research Assistant (Tanzania)
Cesse Valère Mel	Research Assistant (Senegal)
Francis Molua Mwambo ‡	Research Assistant
Abibou Niang	Research Assistant
Oyetunji Olumoye	Research Assistant (Ibadan)
Abdoulaye Sow	Research Assistant (Senegal)
Bonaventure January Tesha	Research Assistant (Tanzania)
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Edjrossè Justin Max-Didier Tchobo *	Research Assistant in Agronomy

Policy, Impact Assessment and Innovation Systems Program

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Aminou Arouna	Impact Assessment Economist
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Rose Edwige Fiamohe	Agricultural Economist
Jean Moreira	Consultant
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Emelina Nieva Caceres Bimpong	Data Analyst and Computer Programmer
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Mandiaye Diagne	PDF Agricultural Economist / Value Chain Specialist (Senegal)
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Eyram Amovin-Assagba	Research Assistant
Abdoulaye Kaboré	Research Assistant

M.M. Florent Kinkingninhoun	Research Assistant
Tebila Nakelse	Research Assistant
Maïmouna Ndour	Research Assistant (Senegal)

Partnership & Capacity Strengthening Division

Samuel Bruce-Oliver	Director, Partnership & Capacity Strengthening
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Rama S. Venkatraman	Multimedia Designer

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Amadou M. Bèye	Representative in Côte d'Ivoire and Seed Systems Expert
Paul Kiepe	Regional Representative for East and Southern Africa (Tanzania)
Francis Nwilene	Regional Representative in Nigeria (Ibadan)
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Seyi Olaoye-Williams	Executive Assistant (Ibadan)
Lansana Koroma	Office Manager (Consultant, Sierra Leone)

Rice Sector Development Program

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Paul Kofi Ayirebi Dartey *	Rice Breeder (Liberia)
Mansour Diop	Research Assistant (Senegal)
Thomas Dubois ‡	Rice Commodity Specialist
Philip Atsaboghena Idinoba	Agronomist / Water Management Specialist (Abuja)
Bert Meertens	Rice Research Coordinator (Sierra Leone)
Mobio Modeste R. N'kou	Research Assistant (Côte d'Ivoire)
Chijioke Maduka Osuji	Rice Value Chain and Postharvest Specialist (Abuja)
Sidi Sanyang*	Rice Commodity Specialist
Ali A. Touré	Agricultural Economist (Sierra Leone)
Johnson Adedayo Adetumbi ‡	Consultant
Boubakary Cissé	Program Assistant
Bernard Firmin Tano	Research Assistant

Marketing & Communications Unit

Savitri Mohapatra	Head of Marketing and Communications
Dohoué Yvette Singbo Dossa‡	Donor Relations Assistant
Mazen El Solh	Project Management and Resource Mobilization Officer

Knowledge Management & Capacity Strengthening Unit

Myra Wopereis-Pura	Head, Knowledge Management & Capacity Strengthening
Marc Winfried Bernard *	Knowledge Management Specialist
Lucie Marie-Chantal Dalie	Training Assistant

Collaborating Scientists

Bertrand Muller	Agro-climatologist (CIRAD, Senegal)
Joël Huat	Vegetable Agronomist (CIRAD)
Philippe Menozzi	Entomologist (CIRAD)
Seiji Yanagihara	Rice Breeder (JIRCAS)
Olivier Husson *	Systems Agronomist/Agro-ecologist (CIRAD)

*Joined in 2014

‡ Left or changed job title in 2014

AfricaRice team members and partners

Postgraduate trainees

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Abebrese, Samuel Oppong Characterization and utilization of novel salinity tolerance donors from traditional African rice varieties using the approach of whole-genome sequencing	University of Ghana, Legon	Ghana	M	IRRI	PhD
Addison, Monica Impact of technology introduction in the rice value chain on gender roles and balances	Kwame Nkrumah University of Science and Technology (KNUST), Ghana	Ghana	F	AfDB	PhD
Agbeleye, Opeyemi Adeola Genetic analysis of anaerobic germination in rice	University of Ibadan, Nigeria	Nigeria	F	Gates Founda-tion	PhD
Amayo, Robert Characterization of pathogen–host–environment relationships for *Magnaporthe grisea* in Uganda	Makerere University, Kampala, Uganda	Uganda	M	IRRI	PhD
Amponsah, Shadrack Post-harvest and mechanization: The role of mechanization towards competitiveness of locally-produced rice	KNUST, Ghana	Ghana	M	AfDB	PhD
Bah, Saidu Estimation of outcrossing in rice using a morphological marker	University of Free State, South Africa	The Gambia	M	Japan	PhD
Basse, Blaise Waly *Évaluation de l'impact des variétés*	Université Gaston Berger, Saint-Louis, Senegal	Senegal	M	EU	PhD
Bilaro, Atugonza Luta Genetic improvement of rice (*Oryza sativa*) for phosphorus deficiency tolerance	Sokoine University of Agriculture, Morogoro, Tanzania	Tanzania	M	Japan	PhD
Bissah, Matilda N. Identification of quantitative trait loci (QTLs) tolerant to salinity in rice (*Oryza sativa*) from traditional African donor and improvement of some popular varieties in Ghana	University of Ghana	Ghana	F	WACCI	PhD
Danvi, Alexandre Hydrological impact of rice intensification in inland valleys	University of Bonn, Germany	Germany	M	Japan	PhD

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Dibba, Lamin Assessing the impact of improved rice technology on household food security in The Gambia	University of Henheim, Germany	The Gambia	M	IRRI	PhD
Diouf, Ndeye Seynabou The impact of NERICA varieties on food security — Role of gender in development strategies of rice	Université Gaston Berger, Saint-Louis, Senegal	Senegal	F	IRRI	PhD
Dossa, Sylvester Molecular analyses of the interaction of rice and *Xanthomonas oryzae* pv. *oryzae* under climate change — The effect of temperature and drought	Leibniz Universität, Hannover, Germany	Benin	M	BMZ/ GIZ	PhD
Duku, Confidence Ecosystem services analysis in West African inland valleys	Wageningen University, Netherlands	Ghana	M	EU	PHD
Gaye, Sokhana Rokhaya *Approche genre dans les chaines de valeurs du riz en Afrique au Sud du Sahara : L'intégration du genre dans la chaine de valeur du riz au Sénégal*	Université Gaston Berger, Saint-Louis, Senegal	Senegal	F	IRRI	PhD
Gayin, Joesph Kwesi How differences in rice starch properties affect functional and nutritional properties of indigenous and improved varieties	Guelph University, Canada	Ghana	M	IRRI	PhD
Hinnou, Leonard Cossi The role of multi-stakeholder platforms (MSPs) in ameliorating the rice value chain	Université d'Abomey-Calavi, Benin	Benin	M	AfDB	PhD
Kabiri, Stella Understanding how host–parasite interactions for economically important parasitic weed species in rainfed rice are differentially affected by present and expected future environmental conditions	Wageningen University, Netherlands	Uganda	F	WUR	PhD
Kante, Nouwodjro Effects of agricultural contracts on the performance of the rice value chain and improvement of living conditions of actors: The case of the Dagana area (Senegal)	Université Gaston Berger, Saint-Louis, Senegal	Senegal	M	AfDB	PhD

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Konate, K. Abdourasmane Identifying morphological features and physiological processes as an integrated overall strategy for tolerance to water deficit in rainfed lowland rice	Université d'Abomey-Calavi, Benin	Burkina Faso	M	GCP	PhD
Kondayen, Arsene *Création variétale et amélioration génétique des plantes*	Université d'Abomey-Calavi, Benin	CAR	M	Japan	PhD
Koudamiloro, Augustin *Caractérisation et étude biomoléculaire des insectes vecteurs de la panachure jaune du riz (RYMV) au Bénin. Perspective de contrôle avec l'huile de neem*	Université d'Abomey-Calavi, Benin	Benin	M	Japan	PhD
Kremer, Johanna Modelling production potential and constraints of rice and maize cultivation in East African wetlands	Bonn University, Germany	Germany	F	GIZ	PhD
Kwesiga, Julius Rice production in the Kilombero flood plain, Ifakara, Tanzania: Effect of water regime and cropping intensity on grain yield and nutrient flows	Bonn University, Germany	Germany	M	GIZ	PhD
Montcho, David *Diversité et bases génétiques des traits liés à la vigueur végétative et à l'adaptation du riz africain aux différentes conditions hydrauliques*	Université d'Abomey-Calavi, Benin	Benin	M	IRRI	PhD
Nanfumba, David Yield gap assessment and development of baskets of good agricultural practices with rice farmers	Makerere University, Uganda	Uganda	M	AfDB	PhD
Ncho, Akahoua Simon Assessing current and future economic, social and environmental impacts of parasitic weeds in rice in sub-Saharan Africa	University of Wageningen, Netherlands	Côte d'Ivoire	M	WUR	PhD
Ndaw, Faye Omar Study of the salt tolerance using suppression subtractive hybridization microarrays and genetic transmission of this character in rice	Université Cheikh Anta Diop, Saint-Louis, Senegal	Senegal	M	IRRI	PhD

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Ndour, Daba *Tolérance du riz au froid*	Université Cheikh Anta Diop, Saint-Louis, Senegal	Senegal	F	Gates Founda-tion	PhD
Niang, Abibou Modeling the effect of nutrient management on rice yield in rainfed upland environment in Africa	University of Bonn, Germany	Senegal	M	IRRI	PhD
Nwobodo, Cynthia Effectiveness of communication tools in disseminating rice technologies	University of Nigeria	Nigeria	F	AfDB	PhD
Ogoundele, Simon Codjo Enhancing value addition through contracts, marketing and branding of rice products	Université d'Abomey-Calavi, Benin	Benin	M	AfDB	PhD
Onaga, Geoffry Impact of climate change on pathogen diversity, and rice gene expression in response to *Magnaporthe oryzae*	Georg August University, Göttingen, Germany	Uganda	M	BMZ/ GIZ	PhD
Oumarou, Souleymane Breeding rice (*Oryza sativa* L.) for salt tolerance in Niger	University of Ghana, Legon	Nigeria	M	WACCI	PhD
Paresys, Lise Ecological intensification of farming systems in inland valleys of Benin through rice and vegetables	University of Wageningen, Netherlands	France	F	EU	PhD
Sangare, Jean Rodrigue *Effets du déficit hydrique chez le riz à l'aide d'une population biparentale : paramètres agromorpho-physiologique et identification des QTLs impliqués dans la tolérance*	Université d'Abomey-Calavi, Benin	Mali	M	GCP	PhD
Santos, Carline *Analyse de l'influence des conditions agro écologiques de cultures sur la résistance du riz aux insectes de stock au Bénin et possibilité d'amélioration de la qualité par étuvage*	Université d'Abomey-Calavi, Benin	Benin	F	IRRI	PhD
Shaibu, Abraham Attah Assessment of the utility of *Oryza glaberrima* in drought tolerance rice breeding	University of Nigeria, Nsukka	Nigeria	M	GCP	PhD

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Sikirou, Mouritala Genetic analysis of iron-toxicity tolerance in rice	Université d'Abomey-Calavi, Benin	Benin	M	Japan	PhD
Tippe, Dennis Developing and disseminating locally adaptable and socially and economically acceptable strategies for prevention and damage control of parasitic weeds in rainfed systems in sub-Saharan Africa	Wageningen University, Netherlands	Tanzania	M	WUR	PhD
Traoré, Abou Understanding how multi-stakeholder platform processes promote value chain innovations in the inland valley systems	Pennsylvania State University, University Park, Pennsylvania, USA	Guinea	M	EU	PhD
Tusekelege, Hezron Pyramiding five bacterial leaf blight resistance genes using MAS into TXD306 variety in Tanzania	Sokoine University of Agriculture, Morogoro, Tanzania	Tanzania	M	BMZ/ GIZ	PhD
Wiredu, Alexander Nimo Impact of a fertilizer subsidy program on farm-level productivity and food security: A case study of rice producers in northern Ghana	University of Hohenheim, Germany	Ghana	M	IRRI	PhD
Yebas, Lydie Marie Françoise *Étude de l'adaptabilité du riz pour l'intensification de la riziculture dans différents écosystèmes de la République du Congo et perspective d'amélioration génétique*	Université d'Abomey-Calavi, Benin	Congo	F	Japan	PhD
Ziegler, Susanne Agricultural use of wetlands scrutinized on sustainability and yield potential—Rice production in the Namulonge inland valley: Effect of different cropping systems on yield and nutrient flows	Bonn University, Germany	Germany	F	GIZ	PhD

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Abiba, Omar Moussa Innovation platforms in the local rice value chain for food security and increased income: The case of Bantè and Glazoué in Benin	Université d'Abomey-Calavi, Benin	Benin	F	AfDB	MSc
Adegbola, Nadege *Revue de politiques commerciales mises en œuvre par les exportateurs et producteurs pour atteindre l'autosuffisance : quelles leçons pour le Bénin ?*	Université d'Abomey-Calavi, Benin	Benin	F	IRRI	MSc
Adegoute, Crepin *Évaluation de la qualité physico-chimique et culinaire de quelques variétés de riz étuvé commercialisées dans certains marchés du sud du Bénin*	Faculté des sciences agronomiques (FSA), Université d'Abomey-Calavi, Benin	Benin	M	Japan	MSc
Adjibogoun, Rodrigue *Étude des caractères génétiques des lignées de riz obtenues par marqueurs moléculaires*	Université d'Abomey-Calavi, Benin	Benin	M	IRRI	MSc
Agossadou, Arsene Juste *Impact du tarif extérieur commun sur l'offre, la demande du riz et sur le revenu des producteurs au Bénin*	Université d'Abomey-Calavi, Benin	Benin	M	Canada	MSc
Akindejuoye, Oludola S. Economic analysis of the nature and performance of contractual arrangements in the rice value chain: Case of Nasarawa and Benue States of Nigeria	University of Ilorin, Nigeria	Nigeria	M	IRRI	MSc
Akintayo, Titilola O. *Caractérisation de différentes collections de la variété Jasmine 85 au Ghana*	Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana	Togo	F	IRRI	MSC
Akodegnon, Gildatte Fifamé *Évaluation de la qualité physico-chimique et culinaire de la variété Sahel 108 en fonction de la fertilisation minérale et de l'incorporation des résidus et paille de blé*	FSA, Université d'Abomey-Calavi, Benin	Benin	F	UEMOA	MSc

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Akoto, Hannah F. Process development and product characteristics of extruded rice (milled and parboiled) and soybean snack	KNUST, Kumasi, Ghana	Ghana	F	IRRI	MSc
Ambaliou, Olounlade O. Impact of contract farming on income of rice farmers: Case of Zou and Collines departments	Université d'Abomey-Calavi, Benin	Benin	M	Japan	MSc
Antwi, Godfred An *ex-ante* analysis of the impact of improved rice postharvest technology adoption on income of rice farming households in Ghana	University of Ghana, Legon	Ghana	M	Canada	MSc
Assouma, Imorou Alidou *Analyse socio-économique selon le genre des effets de la variabilité climatique sur les ménages riziculteurs du centre et du nord-ouest du Bénin*	Université d'Abomey-Calavi, Benin	Benin	M	IRRI	MSc
Azilinon, Cendra Professional training	Institut International de Management (IIM), Cotonou, Benin	Benin	F	AfricaRice	MSc
Baffour, Leonora Process development and product characterization of cowpea fortified extruded breakfast cereal from low-grade rice	KNUST, Kumasi, Ghana	Ghana	F	IRRI	MSc
Balde, Gima *La satisfaction des clients sur la qualité des grains*	Institut Supérieur de Management, Dakar, Senegal	Guinea Bissau	F	UEMOA	MSc
Bates, Paulina Ancona Business models in the rice value chain in Tanzania	Ghent University, Belgium	Mexico	M	Erasmus Mundus	MSc
Biaou Olaye, Romaric *Mécanisation de la riziculture en Afrique subsaharienne*	Université d'Abomey-Calavi, Benin	Benin	M	Canada	MSc
Bizimana, Jean Pierre Analysis of *Xanthomonas oryzae* pv *oryzae* population structure and cultivar resistance in Rwanda	Makerere University, Kampala, Uganda	Rwanda	M	BMZ/ GIZ	MSc

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Boucher, Alexandre *Caractérisation de la régulation naturelle des principaux ravageurs des cultures dans un bas-fond rizicole du Bénin en saison sèche*	Université Paris Sud II, France	France	M	IRRI	MSC
Chin, Rebecca Construction of the pilot plant and the use of multimedia	McGill University, Montreal, Canada	Canada	F	Canada	MSc
Cissé, Boubakary *Analyse des Pôles de développement rizicole : cas des Pôles de Dagana (Sénégal) et du Kouroumari (Mali)*	Université Gaston Berger (UGB), Saint-Louis, Senegal	Mali	M	Japan	MSc
Cissé, Cheikh Amalah *Identification des QTLs liés à tolérance de riz (*Oryza sativa *L.) aux hautes températures dans une population en disjonction, obtenues du croisement NERICA L-20/GIZA 178*	Université Cheik Anta Diop (UCAD), Senegal	Senegal	M	IRRI	MSc
Da Gloria, Khalid *Recherche et étude des logiciels de dessins 3D en mécanique et choix du plus adapté*	Université Africaine des Technologies et de Management (UATM GASA-FORMATION), Benin	Benin	M	Canada	MSc
Dairo, O. Sunday Phenotyping of selected Nigerian *Pantoea* species isolates on potential differential rice accessions	Federal University of Agriculture, Abeokuta, Nigeria	Nigeria	M	Japan	MSc
Daunal, Ibara *Accès au crédit comme une contrainte majeure de commercialisation du riz local au Bénin: facteurs déterminants*	Institut Sous-régional de Statistique et d'Économie Appliquée (ISSEA), Yaoundé, Cameroon	Cameroon	M	Canada	MSc
Dembele, Joseph Sékou *Gestion intégrée des engrais minéraux et résidu de récolte dans un système de production intensif de riz-riz-blé*	Institut polytechnique rural de formation et de recherche appliquée (IPR/IFRA), Koulikoro, Mali	Mali	M	UEMOA	MSc

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Dembele, Mamadou Bréma Agro-morphological evaluation of F_3 lines derived from *Oryza sativa* × *O. sativa* for their high yield potential and adaptability to aerobic growth conditions	IPR/IFRA, Koulikoro, Mali	Mali	M	UEMOA	MSc
Dembele, Moctar *Caractérisation de la sécheresse des bas-fonds rizicoles au Burkina Faso à l'aide de la télédétection*	Institut International d'Ingénierie de l'Eau et de l'Environnement (2iE), Ouagadougou, Burkina Faso	Burkina Faso	M	EU	MSc
Diallo, Cheikh Omar *Identification des QTLs de riz impliqués dans la tolérance à des stress abiotiques*	UGB, Saint-Louis, Senegal	Senegal	M	Gates Founda-tion	MSc
Diarra, Aboubacar Effect of drought on the grain yield of the marker-assisted recurrent selection (MARS) population and polymorphism survey on parental lines with simple sequence repeat markers	Université d'Abomey-Calavi, Benin	Mali	M	GCP	MSc
Diarrisso, Makan Agro-morphological characterization of high yielding varieties for their adaptability to aerobic growth conditions	IPR/IFRA, Koulikoro, Mali	Mali	M	UEMOA	MSc
Diouf, Youssoupha *Étude socio-économique des exploitations agricoles familiales de la VSF, en vue d'apprécier leur niveau de vulnérabilité/ résilience : Fanaye / Boundom*	École Nationale Supérieure d'Agriculture (ENSA), Thies, Senegal	Senegal	M	UEMOA	MSc
Edikou, Koba Espero *Diagnostic de la mini-rizerie de Kérou pour une meilleure gestion technique et économique*	Université d'Abomey-Calavi, Benin	Benin	M	Canada	MSc
Ehirim, Bernard Screening of *Oryza glaberrima* accessions for tolerance to stagnant flooding	University of Ibadan, Nigeria	Nigeria	M	IRRI	MSc
Ekpo, Kotchikpa *Évaluation de la texture et corrélation avec le taux d'amylose de quelques variétés de riz cultivées au Bénin et au Sénégal*	Faculté des Arts et Sciences Techniques, Université d'Abomey-Calavi, Benin	Benin	M	Japan	MSc

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Fantodji, Murielle *Étude de la diversité génétique des populations Ouest africaines de* Magnaporthe oryzae *(agent causal de la pyriculariose), pour un développement efficient et durable des stratégies de control de la maladie*	Université d'Abomey-Calavi, Benin	Benin	F	Japan	MSc
Fatognon, Irene *Demande de riz et préférence des consommateurs au Bénin*	FSA, Université d'Abomey-Calavi, Benin	Benin	F	Canada	MSc
Faye, Souhaibou *Effet du planage au laser sur la gestion de l'eau et le rendement du riz dans la Vallée du Fleuve Sénégal*	ENSA, Thiés, Senegal	Senegal	M	UEMOA	MSc
Forson, Lena Preference mapping and consumer demand for rice in the Accra and Kumasi metropolis	University of Ghana, Legon	Ghana	F	Canada	MSc
Furlan, Theo *Évaluation* ex-ante *des performances agro-environnementales des systèmes de culture riz-maraîchage dans les bas-fonds rizicoles du sud-Benin et du sud-Mali*	Montpellier SupAgro, France	France	M	EU	MSc
Gbebo, Espérance S.F. Dona *Caractéristiques physico-chimiques et culinaires du grain des hybrides F_1 et de leurs parents*	FSA, Université d'Abomey-Calavi, Benin	Benin	F	UEMOA	MSc
Gnacadja, Kouassi Claude *Caractérisation (agromorphologique et moléculaire) et évaluation des propriétés nutritionnelles des variétés traditionnelles de riz africain*	Université d'Abomey-Calavi, Benin	Benin	M	Canada	MSc
Goudanaou, Zaineibou *Analyses génétique de la stérilité male conduite par les facteurs environnementaux chez le riz*	Institut Polytechnique Rural de Formation et de Recherche Appliquée (IPR/IFRA), Katibougou, Mali	Niger	F	UEMOA	MSc

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Hamani, Mounkaila *Criblage et caractérisations génétiques des lignées de riz pour la tolérance à la salinité*	IPR/IFRA, Katibougou, Mali	Niger	M	UEMOA	MSc
Kaboyo, Solomon Distribution and population structure of *M. grisea* in Uganda	Makerere University, Kampala, Uganda	Uganda	M	BMZ/ GIZ	MSc
Kalisa, Alain Distribution and population structure of *M. grisea* in two hot spots in Rwanda	Makerere University, Kampala, Uganda	Rwanda	M	BMZ/ GIZ	MSc
Karama, Amira *Gestion de la fertilité des sols et réponse du riz à la fertilisation minéral dans un système intensif riz–riz–blé au sahel*	IPR/IFRA, Katibougou, Mali	Burkina Faso	F	UEMOA	MSc
Kayongo, Nicholas Farmer participatory variety screening for *Striga hermonthica* resistance in upland rice in Uganda	Makerere University, Kampala, Uganda	Uganda	M	Self	MSc
Kisanga, Peter Estimation of demand and consumers' preferences for quality attributes of rice in Tanzania	Sokoine University of Agriculture, Morogoro, Tanzania	Tanzania	M	AfDB	MSc
Kossi, Kini Pathotyping of isolates of *Pantoea* sp., RYMV and screening for resistance of selected rice accessions in Togo	Université de Ouagadougou, Burkina Faso	Burkina-Faso	M	IRRI	MSc
Kumako, Koffi G. Jerry *Impact des plateformes multi acteurs (PMA) sur la production et le revenu des producteurs du riz au Bénin*	UATM GASA-FORMATION, Benin	Benin	M	EU	MSc
Lavinon, T. Ulrich *Impact socio-économique de la vente groupée du riz par les membres des plateformes multi acteurs (PMA) au Bénin*	UATM GASA-FORMATION, Benin	Benin	M	EU	MSc
Maganga, Reinfrid Martin Analysis of population structure of *M. grisea* and cultivar resistance in three major rice-growing regions of Tanzania	Sokoine University of Agriculture, Morogoro, Tanzania	Tanzania	M	GIZ	MSc

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Mangane, Mary *Caractérisations physiologique et moléculaire de lignées parentales de riz (*Oryza sativa*) utilisées par AfricaRice dans des programmes de tolérance à la salinité*	UGB, Saint-Louis, Senegal	Senegal	F	Japan	MSc
Maureaud, Clémentine Follow-up in-depth analysis of farm systems typologies for scenarios in the Ambohibary hub, Madagascar (ScenaRice project)	Montpellier SupAgro, France	France	F	INRA	MSc
Mgendi, George Comparative analysis of local rice varieties to ascertain its marketing efficiency in Tanzania: Case study of Kahama District	Sokoine University of Agriculture, Morogoro, Tanzania	Tanzania	M	AfDB	MSc
Michodjehoun, Clementine *Étude des caractères génétiques des lignées de riz obtenues par marqueurs moléculaires*	Université d'Abomey-Calavi, Benin	Benin	F	IRRI	MSc
Montcho, Karel Isidore *Influence du temps de récolte sur les propriétés d'usinage, les caractéristiques physico-chimiques et culinaires de certaines variétés de riz* O. glaberrima	FSA, Université d'Abomey-Calavi, Benin	Benin	M	Japan	MSc
Montcho, Perrian A.A *Caractérisation génétique de tous les NERICAs pour la tolérance à la salinité*	Institut IPR/IFRA, Katibougou, Mali	Benin	M	UEMOA	MSc
Mwenda, Meshack Analysis of population structure of bacterial leaf blight and cultivar resistance in three major rice-growing regions of Tanzania	Sokoine University of Agriculture, Morogoro, Tanzania	Tanzania	M	BMZ/ GIZ	MSc
Ndongo, Houleymatou *Besoin en eau et efficacité d'utilisation de l'eau pour le riz dans la vallée du fleuve Sénégal : Site de l'expérimentation station de Fanaye et Ndiaye*	UGB, Saint-Louis, Senegal	Senegal	F	UEMOA	MSc
Nguyen, Duy Nhiem Phenotyping rice roots for P-uptake enhancing traits	University of Leuven (KU Leuven), Belgium	Vietnam	M	IRRI	MSc

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Oluwaseun, Dada Adenike Varietal resistance of rice to blast fungus *Magnaporthe oryzae* in Ibadan, southwestern Nigeria	University of Ibadan, Nigeria	Nigeria	F	IRRI	MSc
Omotoyossi, Laleye Nabilatou *Relation entre la teneur en amylose et les propriétés physico-chimiques, culinaires, rhéologiques et texturales de quelques variétés de riz*	École Polytechnique d'Abomey-Calavi / Université d'Abomey-Calavi, Benin	Benin	F	Canada	MSc
Ongom, Joel Pathogenic diversity of *Xanthomonas oryzae* pv. *oryzae* in Uganda and reaction of rice germplasm to the pathogen	Makerere University, Kampala, Uganda	Uganda	M	BMZ/ GIZ	MSc
Popogbe, Oluwaseun Physiology mechanism of drought tolerance in some upland rice varieties at both reproductive and vegetative stages	Federal University of Agriculture, Abeokuta, Nigeria	Nigeria	M	Self	MSc
Ramos Pires, Ronize Ivan *Stratégies financières à adopter pour minimiser les coûts sur le marché du riz local en Afrique*	Université Dakar-Bouguiba, Senegal	Guinea Bissau	M	UEMOA	MSc
Sanya, Daniel Ruben *Caractérisation de l'isolat de* Xanthomonas oryzae *pv.* oryzae *provenant de Tanguieta, partie nord du Bénin, sur certaines accessions de riz*	Université d'Abomey-Calavi, Benin	Benin	M	IRRI	MSc
Seye, Adama *Détection de QTLs (au stade reproductif) pour l'amélioration de l'adaptation à la salinité en utilisant 3 populations recombinantes de riz en zone sahélienne*	UCAD, Dakar, Senegal	Senegal	M	Gates Founda-tion	MSc
Sodjinou, Bienvenu *Performance de la chaîne de commercialisation du riz local au nord Bénin*	Université d'Abomey-Calavi, Benin	Benin	M	Canada	MSc
Steinbach, Stefanie Validation and application of an algorithm for characterizing inland valley systems using a digital elevation model (DEM)	University of Bonn, Germany	Germany	F	EU	MSc

Name and thesis topic	Institution/ university	Country of origin	Gender	Sponsor	Degree
Tennakoon, Wathsala Construction of the pilot plant and the use of multimedia	McGill University, Montreal, Canada	Canada	F	Canada	MSc
Viboudoulou Vilpoux Mervy *Impact de l'amélioration des technologies post récolte du riz sur la productivité : Cas du battage*	ISSEA, Yaoundé, Cameroon	Cameroon	F	Canada	MSc
Yank, Audrey Construction of the pilot plant and the use of multimedia	McGill University, Montreal, Canada	Canada	F	Canada	MSc
Yelome, Octaviano Igor *Développement de nouvelles sources de résistance durable contre la panachure jaune du riz á partir de l'espèce africaine* Oryza glaberrima *pour une gestion efficace des épidémies en champ*	Université d'Abomey-Calavi, Benin	Benin	M	Japan	MSc
Zipporah, C. Page Genetic variation of iron-toxicity tolerance in lowland rice (*Oryza sativa* L.) varieties	Sokoine University of Agriculture, Morogoro, Tanzania	Liberia	F	Gates Founda-tion	MSc

AfricaRice training programs

Training courses conducted by AfricaRice in 2014

Theme	Location and dates	Total number of participants
Formation sur la mise en place et la gestion des essais	Saint-Louis, Senegal 21 & 23 January	28
Training of seed producers, extension agents and technicians on techniques of production of certified seed and seed marketing	Burkina Faso 22 January to 3 February	80
Video production and dissemination training	Hohoe, Volta, Ghana 23–26 January 2014	14
GPS training	Sierra Leone 23–24 January	8
GPS training	Liberia 27–28 January	11
Training of seed producers, extension agents and technicians on techniques of production of certified seed and seed marketing	Saint-Louis 5–7 February	26
Value chain analysis	Sierra Leone 10–15 February	41
Training to NARS partners/scientists on GAP testing, nutrient-omission trials and mechanical weeder trial protocols	Doho & Olweny hubs, Uganda 14–15 February	9
Researchers trained on yield-gap survey protocol	Namulonge hub, Uganda 17–19 February	13
Site selection and validation (Smart-valleys)	Atakpamé, Togo 17–21 February	17
Training on data analysis for yield-gap survey and development of decision support system for nutrient management	Cotonou, Benin 18–21 February	21
Data collection and sample analysis for generating consumer preference maps	Cotonou 18–21 February	8
Formation sur la construction de la batteuse à riz ASI au Benin par AfricaRice	Centre Songhai, Porto Novo, Benin 24 February to 7 March	12
Multi-stakeholder platform (MSP) facilitation training workshop	Dassa-Zoumé, Collines, Benin 5–7 March	17
Site selection and validation (Smart-valleys)	Kara, Togo 10–14 March	34
Seed production training	Bo, Sierra Leone 17–28 March	20
Accountants' training for AfricaRice partners (French)	Cotonou 18–20 March	17

Theme	Location and dates	Total number of participants
Farmers' leaders training (Smart-valleys)	Kétou, Benin 23–26 March	19
Hands-on training in marker-assisted breeding conducted for researchers from Rokupr Agricultural Research Centre (RARC), Sierra Leone	Saint-Louis 31 March to 11 April	4
Training on Validation AfricaRice Trial (VAT) protocol and rice garden trial protocol	Madagascar 30 April 2014	8
Formation des acteurs locaux sur la production et la certification des semences	Mouila, Gabon 13–19 April	21
Training on experimental auctions	Dar es Salaam, Tanzania 21–25 April	7
Farmers' field days for season 1: Exposure of local farmers to good agricultural practices (GAP) and farmers' practices	Kilombero, Tanzania 22 April to 3 May	90
Training on the selection and adoption of power tillers and two types of reapers	Niono, Mali 22 April to 4 May	21
Farmers' leaders training (Smart-valleys)	Kara 23–25 April	28
Formation sur la production du riz	Saint-Louis 5–23 May	29
Accountants' training for AfricaRice partners (English)	Cotonou 14–16 May	16
SudBiotech 2014: Molecular breeding techniques and bioinformatics	Cotonou 24 May to 2 June	21
Accountants' training for AfricaRice partners (French)	Cotonou 4–6 June	18
Second regional training/workshop on facilitation of the multi-stakeholder platforms (MSPs) in the hubs	Dassa, Benin 23–25 June	19
Information and knowledge exchange facilitators training	Calavi, Cotonou 25–27 June	16
Nutrient-omission trials, good agricultural practices and participatory weeder selection protocol	Democratic Republic of Congo 3–5 July	14
NARS participants trained on GAP testing, nutrient-omission trials and mechanical weeder trial protocols	Ethiopia 4–5 July	3
Opérationnalisation de la collecte décentralisée des données et leur diffusion via les cyber-semences (Sénégal zone nord)	Saint-Louis 21–27 July	20
Training on automation of socioeconomic data analysis	Kigali, Rwanda 4–12 August	16
Site maintenance (Smart-valleys)	Kétou 11–13 August	17

Theme	Location and dates	Total number of participants
Training to NARS partners/scientists on GAP testing, nutrient-omission trials and mechanical weeder trial protocols in	Gikongo 1 & 2 hubs, Rwanda 12–13 August	7
Formation sur l'automatisation de la collecte des données, l'analyse et l'évaluation d'impact	Cotonou 21–29 August	17
Training course on data analysis and management	Saint-Louis 25–29 August	15
Exposure of local farmers to good agricultural practices for cowpea integrated in fields after rice harvest 2014	Kilombero 15–17 September	12
Rice production course	Dar es Salaam 15 September to 3 October	25
Formation avancée sur l'analyse qualitative des données de l'enquête diagnostique – Benin	Cotonou 6–10 October	7
Enumerators' training for the PASIC project on yield-gap survey protocol	Tororo, Uganda 10–12 October	33
Training on the use of MK Insight software	Cotonou 20–22 October	9
Training course on manufacturing the ASI thresher	Saint-Louis 20 October to 9 November	20
Farmers' field days for season 2: Exposure of local farmers to good agricultural practices and farmers' practices	Kilombero 22–25 October	30
Clone – prévenir et détecter les fraudes	Cotonou 23–24 October	16
Training course on milling equipment	Rosso, Mauritania 11–30 November	20
Formation des agents de la DRDR et de FEPRODES sur la collecte décentralisée des données sur les semences et leur diffusion via les cyber-semences (Sénégal zone sud)	Anambe, Senegal 18–20 November	8
Formation logiciel Système d'information géographique QGIS. Diversification des systèmes de culture et gestion agro écologique des bio agresseurs en Afrique de l'Ouest (Divecosys)	Cotonou 24–28 November	15
Formation sur la gestion intégrée de la riziculture	Saint-Louis 1–19 December	27
Rice advice training	Cotonou 8–10 December	6
Formation écriture scientifique. Diversification des systèmes de culture et gestion agro écologique des bio agresseurs en Afrique de l'Ouest (Divecosys)	Cotonou 15–19 December	17

Publications*

Papers published in peer-reviewed journals

Afolabi O, Milan B, Amoussa R, Koebnik R, Poulin L, Szurek B, Habarugira G, Bigirimana J and **Silue D**. 2014. First report of *Xanthomonas oryzae* pv. *oryzicola* causing bacterial leaf streak of rice in Burundi. *Plant Disease*, 98: 1426. http://dx.doi.org/10.1094/PDIS-05-14-0504-PDN

Afolabi O, **Milan B**, Poulin L, Ongom J, Szurek B, Koebnik R and **Silue D**. 2014. First report of *Xanthomonas oryzae* pv. oryzicola causing bacterial leaf streak of rice in Uganda. *Plant Disease*, 98: 1579. http://dx.doi.org/10.1094/PDIS-07-14-0745-PDN

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Abbreviations

ACP	African, Caribbean and Pacific group of states
ADRAO	Association pour le développement de la riziculture en Afrique de l'Ouest (*former French name of* AfricaRice)
AfDB	African Development Bank
AfricaRice	Africa Rice Center
AIDP	Agriculture and Infrastructure Development Project
ANAMBE	Agence nationale d'appui au développement rural (Senegal)
ANR	Agence National de la Recherche
ARICA	Advanced Rice for Africa (varieties)
ASI	ADRAO–SAED–ISRA thresher–cleaner
ATATC	Agricultural Transformation Agenda Thresher–Cleaner (Nigerian version of the 'ASI' thresher–cleaner)
BADEA	Arab Bank for Economic Development in Africa
BMZ	Federal Ministry for Economic Cooperation and Development (Germany)
CAAS	Chinese Academy of Agricultural Sciences
CAR	Central African Republic
CARD	Coalition for African Rice Development
CCAFS	Climate Change, Agriculture and Food Security (CRP)
CFC	Common Fund for Commodities
CIAT	International Center for Tropical Agriculture
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (France)
CORAF/WECARD	West and Central African Council for Research and Development
CRP	CGIAR Research Program
DEA	Diplôme d'études approfondies (postgraduate degree)
DFID	Department for International Development (UK)
DIIVA	Diffusion and Impact of Improved Crop Varieties in Africa
DRC	Democratic Republic of Congo
DRDR	Direction régionale du développement rural (Senegal)
ECOWAS	Economic Community of West African States
ESA	East and Southern Africa
ESCAPE	Changements Environnementaux et Socio en Afrique : Passe, Présent et Future
EU	European Union
F	female
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FCFA	CFA franc
FEPRODES	Fédération des groupements et associations des femmes productrices de la région Saint-Louis (Senegal)
FMARD	Federal Ministry of Agriculture and Rural Development (Nigeria)
FOFIFA	Centre National de Recherche Appliquée au Développement Rural (Madagascar)

FTF	Feed the Future
GAP	good agricultural practices
GCARD	Global Conference on Agricultural Research for Development
GCP	Generation Challenge Program (CGIAR)
GES	Growth Enhancement Support (Nigeria)
GIS	geographic information systems
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRiSP	Global Rice Science Partnership
GSR	Green Super Rice (project)
GYGA	Global Yield Gap Atlas
IBRD	International Bank for Reconstruction and Development (World Bank)
ICT	information and communications technology
IER	Institute d'économie rurale (Mali)
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
IKEF	information and knowledge exchange facilitator
INERA	Institut de l'envrionnement et de recherches agricoles (Burkina Faso)
INRAB	Institut national de recherches agricoles du Bénin
IP	innovation platform
IRD	Institut de recherche pour le développement (France)
IRRI	International Rice Research Institute
ISRA	Institut sénégalais de recherches agricoles (Senegal)
JIRCAS	Japan International Research Center for Agricultural Sciences
LABOSEM	Laboratoires de semences
LARES	Laboratoire d'Analyse Régionale et d'Expertise Sociale
M	male
M&E	monitoring and evaluation
MAS	marker-assisted selection
MICCORDEA	Mitigating the Impact of Climate Change on Rice Disease Resistance in East Africa
MSc	Master of Science (postgraduate degree)
MSP	multi-stakeholder platform
Mt	million tonnes
NAM	Nested Association Mapping (project)
NARS	national agricultural research system(s)
NCAM	National Centre for Agricultural Mechanization (Nigeria)
NEC	National Experts Committee (AfricaRice)
NERICA	New Rice for Africa (family of interspecific rice varieties for uplands)

NERICA-L	New Rice for Africa (family of interspecific rice varieties for lowlands)
NGO	non-governmental organization
PDF	Post-Doctoral Fellow
PhD	Doctor of Philosophy (doctoral degree)
pp.	pages
pv.	pathovar
PVS	participatory varietal selection
QTL	quantitative trait locus
R&D	research and development
RAP	Realizing the agricultural potential inland valley lowlands in sub-Saharan Africa while maintaining their environmental services
RTA	Rice Transformation Agenda (Nigeria)
RYMV	*Rice yellow mottle virus*
SAED	Société d'Aménagement et d'Exploitation des terres du Delta et des vallées du fleuve Sénégal et de la Falémé (Senegal)
SARD-SC	Multinational CGIAR Support to Agricultural Research for Development on Strategic Commodities in Africa (project)
SMART-IV	Sawah, Market Access and Rice Technologies for Inland Valleys
STRASA	Stress Tolerant Rice for Poor Farmers in Africa and South Asia
TCDC	Technical Cooperation among Developing Countries (UNDP)
UEMOA	West African Economic and Monetary Union (Union Économique et Monétaire Ouest Africaine)
UNDP	United Nations Development Programme
US	United States
USA	United States of America
USAID	United States Agency for International Development
WAAPP	West Africa Agricultural Productivity Program (World Bank)
WARDA	West Africa Rice Development Association (*former name of* AfricaRice)
WCA	West and Central Africa
WECARD	West and Central African Council for Research and Development

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CGIAR is a global partnership that unites organizations engaged in research for a food secure future. CGIAR research is dedicated to reducing rural poverty, increasing food security, improving human health and nutrition, and ensuring more sustainable management of natural resources. It is carried out by the 15 centers who are members of the CGIAR Consortium in close collaboration with hundreds of partner organizations, including national and regional research institutes, civil society organizations, academia, and the private sector.

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The Centers

AfricaRice	Africa Rice Center (Cotonou, Benin)
Bioversity	Bioversity International (Rome, Italy)
CIAT	International Center for Tropical Agriculture (Cali, Colombia)
CIFOR	Center for International Forestry Research (Bogor, Indonesia)
CIMMYT	International Maize and Wheat Improvement Center (Mexico, DF, Mexico)
CIP	International Potato Center (Lima, Peru)
ICARDA	International Center for Agricultural Research in the Dry Areas (Beirut, Lebanon)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics (Patancheru, India)
IFPRI	International Food Policy Research Institute (Washington, DC, USA)
IITA	International Institute of Tropical Agriculture (Ibadan, Nigeria)
ILRI	International Livestock Research Institute (Nairobi, Kenya)
IRRI	International Rice Research Institute (Los Baños, Philippines)
IWMI	International Water Management Institute (Colombo, Sri Lanka)
World Agroforestry	World Agroforestry Centre (Nairobi, Kenya)
WorldFish	WorldFish Center (Penang, Malaysia)

AfricaRice

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