



AfricaRice

Investing in rice research and innovation for Africa

Africa Rice Center (AfricaRice) – Annual Report 2015

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Cover: Assessing trials in a screen-house during a field day, AfricaRice Senegal station, Ndiaye.

About Africa Rice Center (AfricaRice)

AfricaRice is a CGIAR Research Center — part of a global research partnership for a food-secure future. It is also an intergovernmental association of African member countries. The Center was created in 1970 by 11 African countries. Today its membership comprises 26 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, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Mauritania, Niger, Nigeria, Republic of Congo, Rwanda, Senegal, Sierra Leone, Togo and Uganda. AfricaRice headquarters is based in Côte d'Ivoire. Staff members are located in Côte d'Ivoire and also in AfricaRice research stations in Benin, Ghana, Liberia, Madagascar, Nigeria, Senegal, Sierra Leone and Tanzania.

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AfricaRice

Message from the Board Chair and Director General

Coming under new management in March 2015 with the appointment of a new Director General, **Dr Harold Roy-Macauley**, the Center remains committed to grow as a pan-African center of excellence for rice research, development and capacity-strengthening. Going forward, we will continue to draw on worldwide expertise and knowledge to develop solutions to challenges across Africa. Our strategic priorities for effective research delivery will include the following: (i) strengthening partnerships; (ii) developing the capacity of rice value-chain actors including youth and women; (iii) improving access to markets for rice

producers; (iv) raising the profile of rice science in national policy agendas; and (v) increasing investments in research for development for the rice sector in Africa. This year's research-for-development activities continued to contribute to the global and continental agenda including the United Nations' Sustainable Development Goals and the Comprehensive African Agriculture Development Programme (CAADP) as translated by the Malabo Declaration on 'Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods'. We will build on our strengths for delivering outputs, outcomes and



Chair of the Board of Trustees, Dr Peter Matlon (left), with Director General, Dr Harold Roy-Macauley

impacts for rice value-chain stakeholders across Africa to facilitate effective alignment and contribution to these agendas. Our strategy has been to move from ‘project delivery’ to ‘product delivery’ to ensure that research conducted by AfricaRice and its partners really works for development. We will emphasize this further in the years to come by streamlining how we organize and conduct our research.

The 2015 report features key achievements, especially in the areas of product development and delivery, and presents important emerging issues related to the rice sector, including climate change resilience, enhancing rice genetic resources and varietal development, delivery of value-for-money rice innovations, disaster response and rice self-sufficiency. We purport that these achievements clearly demonstrate to our clients the importance of **investing in rice research and innovation for Africa** — the theme of this year’s annual report.

Rice production systems becoming more resilient to climate change

Close research collaboration with the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), led by our sister CGIAR center, the International Center for Tropical Agriculture (CIAT), provided insights on how to optimize output and how the resource and financial balance sheets measure up in rice-growing systems across Africa. These results will help sensitize policy-makers and development partners on opportunities to prioritize climate-smart agriculture at national level.

Strengthening rice genetic resources, varietal development and seed systems

Continued strong partnership between AfricaRice and the Crop Trust has resulted, this year, in significant strengthening of the capacity of the AfricaRice genebank, which is housing rice genetic resources that are key to developing new products that address emerging challenges of the rice sector in Africa. The

Crop Trust’s support is even more invaluable as we relocate AfricaRice Headquarters from Benin to Côte d’Ivoire and upgrade the genebank to world-class standards. In the future, the genebank will become the ‘Africa rice biodiversity center’. Moreover, a focus in 2015 has been the use of these resources to breed new rice varieties for greater tolerance or resistance to today’s (and tomorrow’s) major biotic and abiotic stresses facing rice systems and farmers. This provides an opportunity to succeed in meeting the rapidly growing demand for rice in the face of major stresses in Africa.

Support provided by AfricaRice to Member States has resulted in strengthened functional seed systems with increased provision of good-quality seeds, which are the first inputs in the development of beneficial rice products. This has provided some relief to rice farming across the continent, which suffers generally from low availability of good-quality seeds.

Obtaining value for money from rice

AfricaRice has enhanced product delivery in the rice-sector development hubs in African countries by fully integrating innovation systems approaches through innovation platforms (IPs), to show clients that its research is meaningful and constitutes value for money. In these platforms, individuals from different organizations and with different backgrounds and interests, come together to diagnose problems, identify opportunities and find ways to make rice value chains more effective and efficient. The promotion of IPs has been the focus of a major initiative, supported by the African Development Bank, under the title ‘Multinational CGIAR support to agricultural research for development on strategic commodities in Africa’ (SARD-SC).

The dissemination in the rice hubs during 2015, of an energy-efficient and durable-material (GEM) parboiling technology that combines a uniform steam parboiler and an improved parboiling stove significantly improved rice quality. Traditional

methods of harvesting and processing have often resulted in unacceptable losses over the years in the rice value chain. The intense promotion of especially new small-scale machinery through the AfricaRice mechanization task force has helped smallholders to significantly reduce postharvest losses and improve grain quality. Rice-based bio-energy sources and nutritious food products developed by AfricaRice, while addressing wastage along the value chain, have also provided rural households with cheap energy while improving food and nutrition security for growing populations.

AfricaRice is currently exploiting business models that recognize not only the importance of every single actor of the rice value chain, but also the importance of establishing tangible partnerships with each of them, for catalyzing the adoption and use of scalable technologies in Africa. Within the SARD-SC project, the involvement of women and youths, who do or have the potential to do much of the work at every link in the chain, in IP activities has been systematically encouraged. The ‘Catalyzing the adoption and use of scalable technologies in Africa’ (CAUSA) project funded by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), provided support to train young graduates as service providers to serve smallholder farmers and small-scale processors, which led to increased adoption and use of scalable technologies in Benin and Togo.

Responding to disasters

The post-conflict states of Liberia and Sierra Leone, and their neighbor Guinea, took another blow in 2014–2015, when the Ebola outbreak inflicted devastating damage across their economies, including the rice sector. This epidemic revealed the lack of functional seed systems in these countries. AfricaRice has contributed to rebuilding the rice sector in these countries by scaling out technologies, particularly seeds, via various impact-enhancing mechanisms such as the IPs and task forces.

Strengthening rice information systems

Attaining rice self-sufficiency is a major ambition of most rice-consuming countries in Africa. Getting the statistics right, however, is of vital importance if they are to succeed. Continued efforts have been made to upgrade rice statistics at the national level. This will be an important basis for measuring the performance of efforts to improve rice production, an important element in the equation for rice self-sufficiency.

Relocating while still on course

After 10 years of being warmly hosted by Benin, AfricaRice initiated its official return of its Headquarters to Côte d’Ivoire. In welcoming AfricaRice back home, the Government of Côte d’Ivoire offered a building in Abidjan, to which the AfricaRice Directorate relocated in September 2015.

Housing the directorate in this new location in Abidjan facilitates management’s interaction with its partners at both national and international levels. We hope to complete relocation of the remaining administrative functions and the Center’s core research-for-development resources to the M’bé Research Station near Bouaké, by mid-2017.

AfricaRice pursues a decentralized strategy, with activities located in several research facilities across the continent. Work is ongoing to strengthen corporate service functions to support the decentralized structure and the ever-growing demands of its Member States.

Like all CGIAR centers, however, AfricaRice faces serious financial challenges attributed to significant and erratic cuts in CGIAR funding, particularly to the Global Rice Science Partnership (GRiSP), the CGIAR Research Program on rice.

The high cost of the relocation process has further aggravated this situation. Management has established a strong resource-mobilization strategy and is working tirelessly to stabilize the financial situation over the coming two years.

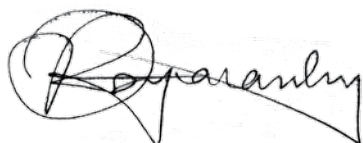
Acknowledgments make a difference

We would like to express sincere thanks to our esteemed colleague, Interim Director General Dr Adama Traoré, as he bows out of the scene after 18 months at the helm.

We also wish to thank the Council of Ministers for endorsing the Board's selection of the new Director General, and for its strong support to the Center. We recognize the dedication and professionalism of

our scientific and administrative staff. We also wish to thank our financial, scientific and development partners, both within and outside of Africa, for their untiring efforts in 2015. Working with us, they demonstrate the value of investing in rice research and innovation for Africa, and the value of our work to our clients, especially the poor rice farmers and consumers across Africa.

We hope you enjoy reading about our work as much as we enjoy doing it.



Harold Roy-Macauley



Peter Matlon

Research and innovation highlights

Rice production becoming more resilient to climate change

How climate change will affect rice production in Africa is a fundamental question that should perhaps be underlying all of AfricaRice's research for development.

Before we can answer this question, we first have to know what the projections are for climate parameters that affect rice production in Africa. AfricaRice remote sensing and GIS unit, under the umbrella of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), conducted a "first analysis of climate changes in Africa" in relation to rice production zones and growing seasons.

Remote sensing and GIS specialist Sander Zwart summarizes the work: "We combined spatial data sets on the growing seasons and the location of rice with climate change scenarios presenting minimum and maximum temperatures and precipitation for different time slices and climate projections. It gives an insight of where temperature and precipitation will change during the growing season and with which magnitude."

Climate change is affecting key parameters for rice production such as maximum and minimum temperatures, rainfall amounts and patterns, relative humidity, and salinity. The analysis focused on temperatures and rainfall. When the maximum temperature is too high, rice suffers heat-induced spikelet sterility, which severely limits yield. The Sahel, for example, already has maximum temperatures close to the threshold for spikelet sterility, so any increase could shift or shorten the rice-growing season, or even

make production of existing rice varieties impossible. Meanwhile, high minimum (night) temperatures can reduce assimilation of nutrients, thus hampering crop growth and grain production. Low total rainfall and high-intensity rainfall events may lead to longer drought spells and an increase in the number and severity of floods in inland valleys and lowlands.

Zwart modeled total seasonal rainfall (precipitation), and average minimum and maximum temperatures for both main and 'off' seasons. The outputs were maps of predicted changes per season, predicted changes per Representative Concentration Pathway (RCP), and reports of expected changes per country.

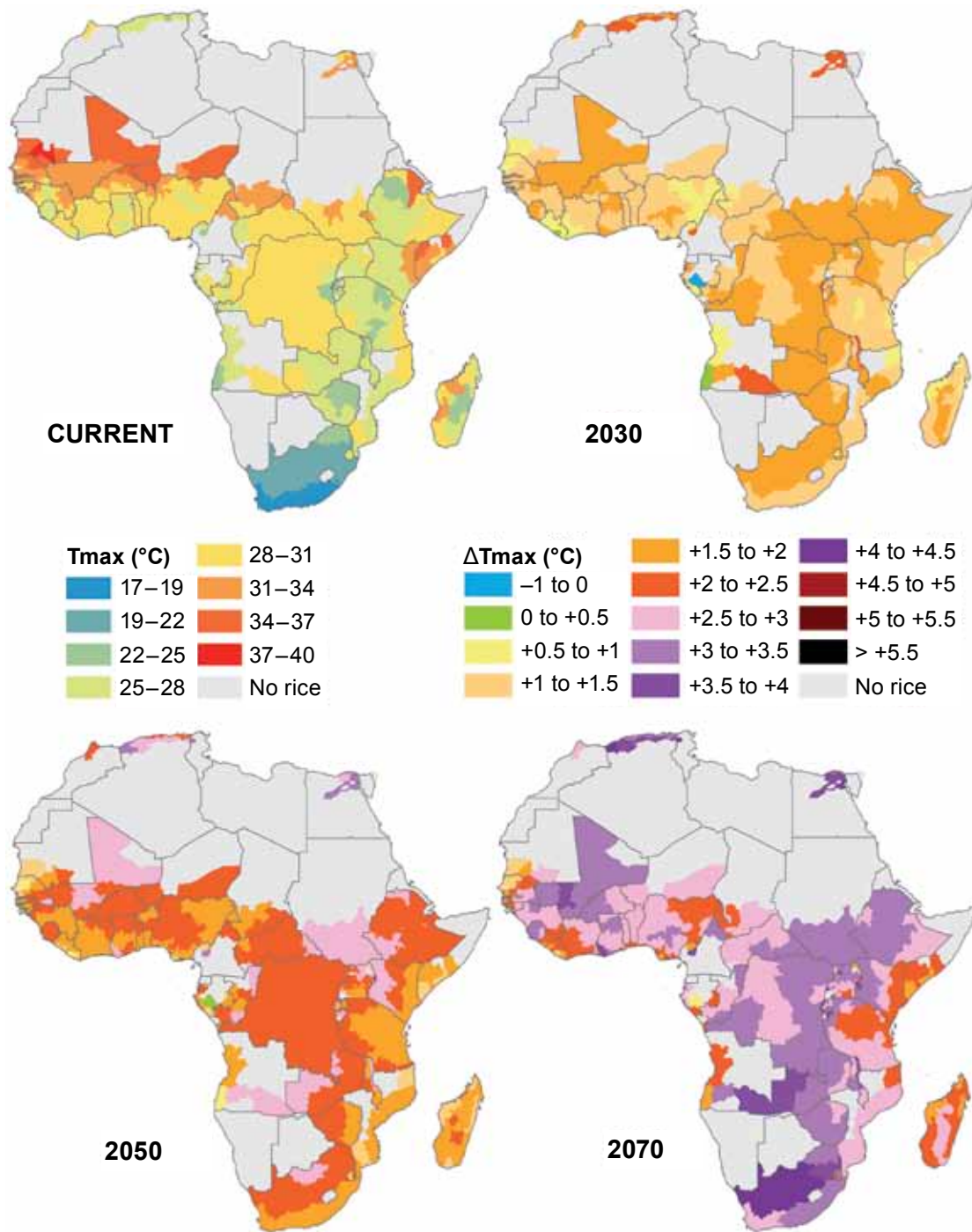
For the Sahel, the assessment predicts slight increases in overall precipitation across the region in both seasons, massive increases in southern Niger, northern Nigeria and southern Chad in the main season, and massive increases in southwest Niger and neighboring northwest Nigeria, and part of southwest Chad in the off-season. Meanwhile, temperatures will increase across the region (*see figure opposite*), with Mali showing the biggest changes in maximum temperature across all scenarios in both seasons. Northern Mali and central-south Niger, and southwest Niger are predicted to be the worst affected areas in terms of increases in minimum temperature in the main season and in the off-season, respectively.

The ORYZA2000 crop model¹ will use the temperature data to determine the impact of the modeled changes on rice yields.

Contact: Sander Zwart, Remote sensing and GIS specialist <s.zwart@cgiar.org>

¹ See 'Improving climate-risk simulation for arid areas', *AfricaRice annual report 2013*, pages 27–29.





Current and projected changes in maximum temperature for rice-growing regions of Africa using Intergovernmental Panel on Climate Change (IPCC) scenario RCP 6.0 (main rice season)

A crop model to optimize resource use and farm income

Under the umbrella of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), AfricaRice crop modeler Pepijn van Oort used computer simulation model ORYZA2000¹ to predict the timings and yields of different rice and vegetable crop combinations to determine which would optimize resource use and output in the Senegal River valley.

According to van Oort, one key in making crop models usable for the real world is “the lessons learned in the process of moving from poor prediction to more accurate prediction.” Early simulations were performed to maximize yield and “optimum sowing dates differed completely from what farmers were doing.” The decision was then made to bring agronomists, breeders, economists and farmers into the discussions. “This led to the incorporation of vegetables and optimizing yield–crop duration and considering flexibility.”

Double cropping medium-duration rice varieties proved the best option in the simulation, with the combined yield of the two crops being almost double that of a single crop. This simulation also provided plenty of flexibility in planting dates, which means that it is feasible for smallholders who often cannot plant on the ‘optimum’ date.

At the end of the day, the simulation backed up what progressive farmers in the valley are already doing: double cropping, either rice–rice or rice–vegetable, to optimize the use of land for family food and income.

“The nice thing about this model is that, once it is finished, it can easily be used for scenarios in other locations,” says van Oort. “We will extend it to all the rice hubs that have an irrigated component, and also build in climate change predictions. Then we will have an idea whether farmers are currently optimizing their incomes and of what the future might hold.”

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¹ See also ‘Improving climate-risk simulation for arid areas’, *AfricaRice annual report 2013*, pages 27–29.

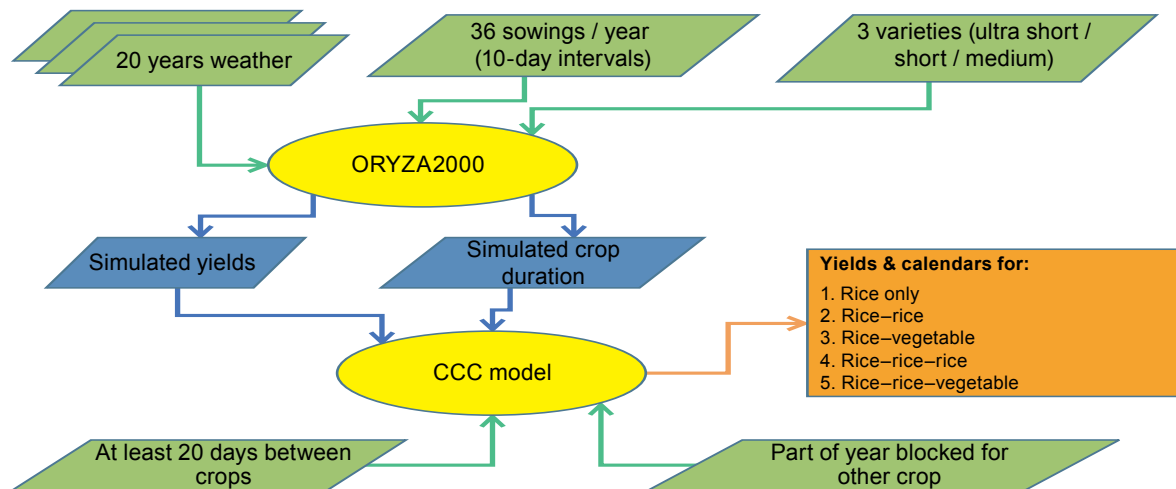


Illustration of how the modeling works

Green: input data and assumptions; yellow: models; blue: ORYZA2000 outputs fed into crop calendar construction (CCC) model; orange: outputs

Securing the future through genetic resources

Crop genetic resources provide the raw materials for breeding new varieties in changing environments. The AfricaRice genebank, currently in Cotonou, Benin, has received a lot of support from the Crop Trust and the CGIAR Research Program for Managing and Sustaining Crop Collections (Genebanks CRP).

“We hold the largest collection of African rice in the world and the largest rice collection in Africa with over 20,000 accessions,” says head of the AfricaRice Genetic Resources Unit Marie-Noëlle Ndjiondjop.

The genebank at Cotonou is for medium-term storage and it is the first storage facility for incoming materials. AfricaRice also maintains long-term storage of its materials in the genebank of the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria.

With the support of the Crop Trust, AfricaRice also ‘safety duplicates’ material in long-term mega-stores in the US National Center for Genetic Resources Preservation (NCGRP), Fort Collins, Colorado, and in the Svalbard Global Seed Vault, Norway. Since 2010, AfricaRice has substantially increased its rate of duplication to these two mega-stores from 27% to 40%.

With the assistance of the Crop Trust, AfricaRice has upgraded its quality management system with standard operating procedures and its data management to the genebank standards of the Food and Agriculture Organization of the United Nations (FAO).

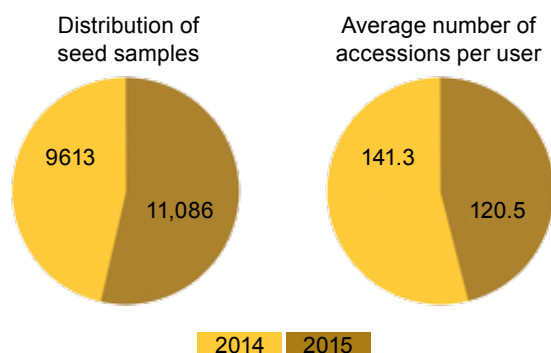
Passport and minimum characterization data of 19,867 AfricaRice accessions are now available via the Crop Trust’s Genesys plant genetic resources portal.¹ This means that a rice breeder anywhere in the world can access information on AfricaRice genebank holdings.

Of the 19,954 accessions conserved in medium-term storage, 15,596 were legally and physically available (78% of the collection) for distribution by the end of 2015 — up from 70% in 2013.

AfricaRice is going ‘home’ and taking its genetic resources with it but into a new world-class genebank under construction at the Research Station in M’bé. The material will be moved when it is totally secured in long-term storage and the viability of medium-term samples verified.

Contact: Marie-Noëlle Ndjiondjop, Head of Genetic Resources Unit <m.ndjiondjop@cgiar.org>

¹ www.genesys-pgr.org/



From 2011 to 2015, AfricaRice dispatched an average of 13,283 seed samples per year, each one requiring an import permit and a phytosanitary certificate



Marie-Noëlle Ndjiondjop providing instructions to the team inside the medium-term store, AfricaRice station, Cotonou, Benin (© GIZ / Klaus Wohlmann)

Managing stresses on rice for the benefit of African farmers

AfricaRice and its partners are actively introducing and breeding new varieties that are resistant to the prevailing biotic and abiotic stresses in Africa through the implementation of two projects funded by the Bill & Melinda Gates Foundation (STRASA and Green Super Rice). This involves accessing varieties tolerant to abiotic stresses and harnessing Chinese rice breeding capacity for Africa. As a result, in 2015, Madagascar, Mozambique and Nigeria released five new rice varieties.

Some fifth-generation progeny of crosses involving NERICA 4 and NERICA 7 (the most drought-tolerant materials available) yielded over 4 t/ha under drought in trials conducted in 2015 — that is, double the drought-tolerant check's yield of 2 t/ha!

Some developed lines that have combined tolerances — drought and iron-toxicity, drought and submergence, and cold and salinity — have higher yields than long-time lowland favorite WITA 4 and irrigated lowland favorite Sahel 108 even without stress, and were entered into breeding task force trials in 2015.

The *Sub1* gene (submergence tolerance) has been introgressed into near-isogenic lines (with 95% of

the mega-variety parent's genome) developed from WITA 4 and NERICA-L 19. Some of these lines now yield over 4 t/ha after nearly 2 weeks of submergence. In 2015, these lines were evaluated on-farm in six states of Nigeria, and seed was taken to Liberia and Sierra Leone for validation and fast-track release.

Salinity-tolerant versions of popular irrigated rice varieties — Rassi and Sahel 108 — were included in 2015 field trials in The Gambia, where the best lines yielded 1.5 t/ha more than the partly tolerant but long-duration local variety.¹

Twenty-seven hybrid varieties, out of over 200 developed by AfricaRice, were subjected to multi-environment testing in Mali, Mauritania, Nigeria and Senegal. Ten of them showed 15–20% yield advantage over the inbred check (Sahel 108).

In 2015, over 7000 tonnes of seeds of new varieties were produced across 11 countries (*see* Table 1). This level of production suggests strong potential impact of these varieties. Moreover, there is strong demand for them because of their tolerance to the very stresses that threaten farmers' livelihoods as a result of climate change.

Contact: Baboucarr Manneh, irrigated rice breeder <b.manneh@cgiar.org>

¹ For more details on the breeding for salinity tolerance, *see* 'Breeding for salinity tolerance — the *Saltol* gene', *AfricaRice annual report 2013*, pages 29–32.

Table 1. Seed production of new varieties, 2015

Seed type	No. countries	No. varieties	Amount (tonnes)	Stresses targeted (or yield)
Breeder	8	53	14.1	Cold, drought, iron toxicity, salinity, submergence, yield
Foundation	6	26	168.0	Cold, drought, iron toxicity, submergence, yield
Certified	8	26	7628.3	Cold, drought, iron toxicity, submergence, yield
Total	11	88	7810.4	

Combating African rice diseases

The major diseases of rice are the focus of a GRiSP-supported ‘New Frontier’ project.

African rice diseases are genetically very diverse, so it is important to have the widest possible selection of isolates from across the continent to cover much of this diversity. New strains of *Rice yellow mottle virus* (RYMV), rice blast (fungus, *Magnaporthe oryzae*) and bacterial blight (*Xanthomonas oryzae* pv. *oryzae*) were collected in 14 countries.

Diagnoses of the diseased samples caused a major surprise to the African plant pathology community. The majority of diseases identified as bacterial blight were not caused by *X. oryzae* at all but rather by other bacteria of the genera *Pantoea* and *Sphingomonas*, both previously unknown in Africa. Also for the first time, genuine bacterial leaf streak, *X. oryzae* pv. *oryzicola*, was identified in Burundi, Madagascar and Uganda, and genuine *X. oryzae* pv. *oryzae* in Benin and Uganda.

Microsatellite and multi-locus genotype markers showed that East and West African rice blast populations are different. A set of 105 isolates representing

the African pathogen’s diversity was documented for the first time. The genetic basis of new blast resistance in rice can now be determined simply by screening against a subset of those isolates native to the country where the work is taking place.

A third RYMV resistance gene was recently discovered and 12 highly resistant *Oryza barthii* accessions identified.

Three NERICA and four NERICA-L varieties showed resistance to both *X. oryzae* pv. *oryzae* and *X. o.* pv. *oryzicola*.

Surveys carried out across all 12 of Benin’s departments yielded 29 isolates of three species of nematodes in the genus *Meloidogyne*.

The collection of new isolates of the major rice diseases and new resistance in *Oryza* germplasm will enable breeders to develop varieties with durable (effective across a wide area and long lasting) resistance for farmers.

Contact: Drissa Silué, Plant pathologist
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Left: Rice field infected with *Pantoea* sp., Ndiaye, Senegal, 2014. Center: Close-up of leaf symptoms of *Pantoea* infection. Right: Leaf blight caused by *Sphingomonas* sp., Sapu, The Gambia, 2014

Giving farmers the chance to win the fight against witchweed

Striga or witchweed is an obligate root hemiparasite of cereal crops, including rice. It can have devastating effects on a rice crop, taking away nutrients, stunting the crop plant's growth and reducing farmer's yield, sometimes to the extent of inflicting total crop loss. Moreover, it tends to get worse over the years if the field is used for growing the same cereal in consecutive seasons.

Under the 'Striga resistance genes for Africa' (StRiGA) project, funded by the UK Department for International Development (DFID), the UK Biotechnology and Biological Sciences Research Council (BBSRC) and the Bill & Melinda Gates Foundation, AfricaRice, Icipe, Kenyatta University (Kenya), the University of Makerere (Uganda) and the University of Sheffield (UK) are identifying rice varieties that are resistant or tolerant to *Striga*,¹ and assessing the variability of *Striga* virulence across countries and over time.

Striga exhibits very high genetic variation. There are some very resistant rice varieties that have become highly susceptible to yield loss once *Striga* has overcome their resistance.

Rice varieties were selected on the basis of their resistance or tolerance to *Striga*, and a set of 25 varieties screened in Kenya, Tanzania and Uganda. Loss in host-plant photosynthesis and height proved good indicators of tolerance.

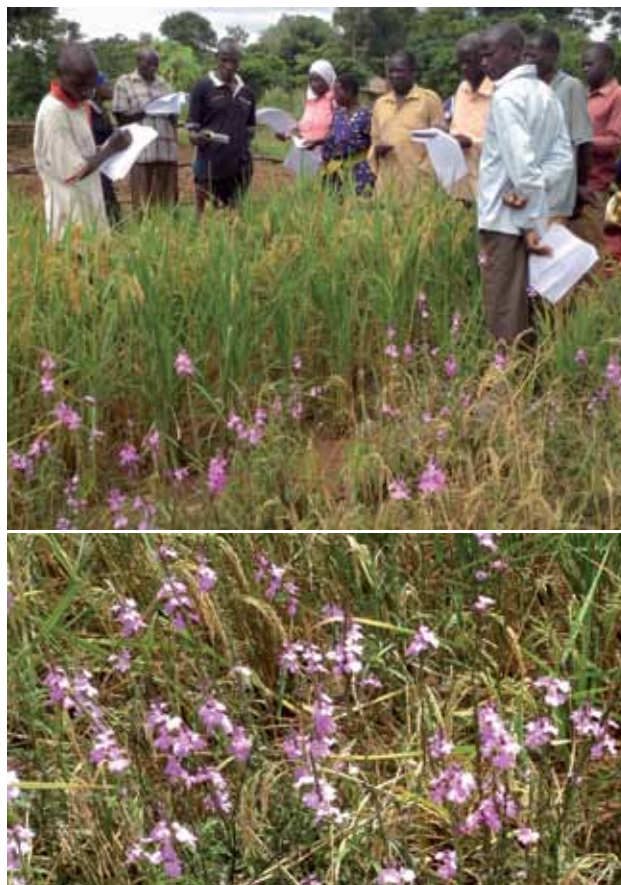
A number of varieties were identified that were at least as resistant or tolerant to *Striga* and yielded at least as much grain as the *Striga*-resistant check, NERICA 2. Farmers in Uganda were particularly enthusiastic about these highly resistant varieties, which include NERICA 10, NERICA 17 and SCRID090 from Madagascar, and requested seeds. AfricaRice supplied a small quantity of seed and encouraged the farmers to grow these in small plots alongside their usual variety.

¹ 'Resistance' is a plant's ability to prevent parasitization and 'tolerance' is a plant's ability to produce grain *despite* being parasitized.

During field visits, the farmers were very proud of the performance of these varieties in their fields.

Uganda released NERICA 10 almost a decade ago, and seeds are being produced commercially. NERICA 17 and SCRID090 still have to go through the official release channels. It seems, however, that the farmers are not waiting for that to happen as they are saving the grains as seed and multiplying the varieties themselves!

Contact: Jonne Rodenburg, Agronomist
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Top: Participatory variety selection with farmers, Uganda.
Bottom: close-up of *Striga* flowers.

Strengthening seed systems to contribute to boosting domestic rice production

Access to quality rice seed is a challenge in many countries in Africa. As part of the CGIAR Partnership for Scaling of Improved Seed Varieties Program, AfricaRice and its partners initiated a ‘Seed scaling technical assistance project’ in Ghana, Liberia, Nigeria and Senegal, funded by the United States Agency for International Development (USAID).

Ghana is improving seed planning; connecting actors along the rice-seed value chain, and strengthening their capacity; facilitating access to appropriate equipment from production to processing and storage; and encouraging farmers to use quality rice seed. In 2015, a seed plan was prepared with stakeholders to improve seed marketing; the project established 75 demonstrations in farmers’ fields to generate demand for Certified seed; and technicians were trained in seed production. Technicians were attached to private seed companies to supervise Certified seed production.

In Liberia, AfricaRice helped establish a national Seed Board — initially government-managed, the private sector will come on board later. Unfortunately, the 2015 work plan in Liberia was completely disrupted by the Ebola epidemic.

In Nigeria, stakeholders identified two major activities: rejuvenating the nucleus seed of released varieties to maintain the genetic purity of Breeder seed; and enhancing the technical capacity to produce high-quality Breeder, Foundation and Certified seed. In 2015, the project rejuvenated the nucleus seed of six popular varieties, and established a consortium of 10 private seed companies to produce quality seed.

Senegal already has an established seed certification system. Project activities focus on improving the system’s performance and integrating the private sector into it. During the first season of 2015, the project produced 3.75 tonnes of Breeder seed of seven varieties, from which eight private seed companies

produced Foundation seed in the second 2015 season. In the second season, the project produced another 7.1 t of Breeder seed of the same varieties for use in 2016.

The project is expected to be fully operational in all four countries in 2016 and 2017, as the Ebola epidemic was contained in 2015.

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Seed producer Iddrisu Akolbire in his field of IR841, which he is growing for Certified seed, Nyariga, Vea irrigation scheme, Bolgatanga, Upper East Region, Ghana

Research and innovation highlights

GEM parboiling demonstrated as a cauldron for quality rice and revenue generation

The ‘Multinational CGIAR support to agricultural research for development on strategic commodities in Africa’ project, funded by the African Development Bank (AfDB), takes existing or newly developed technologies, innovations and ideas, including improved varieties, to the innovation platforms (IPs). Most of the IPs are focusing on two business products — parboiled rice and milled rice.

The GEM parboiler produces quality rice, is of high-quality construction, is energy efficient, and processes large quantities of rice relatively quickly. Within the IPs it is being targeted to women processors, marketers and youths.

Women processors from Glazoué, Benin, evaluated the GEM in March 2015. They “loved” it, but recommended various modifications, especially concerning system capacity. AfricaRice then installed and tested the technology in Glazoué, and facilitated further training in the use of the modified GEM, helping the processors to initiate a rice parboiling business. Subsequently, the processors in Glazoué have seen the price of their rice rise by 25%.

Training strategy

AfricaRice’s long-term strategy follows a ‘training of trainers’ model. For the Glazoué IP, AfricaRice brought 12 leading processors — strategically chosen for their influence within the community — to its Cotonou research station for training as trainers.

AfricaRice also encourages the establishment of a community of practice by the trainers and those they train, so that there is ongoing mutual support. AfricaRice and Institut national de recherches agricoles du Bénin (INRAB) provide technical backstopping for any challenges, such as gaps in knowledge and repair of equipment.

Six processors from Malanville, Benin, were trained in Glazoué. They were then the key resource persons for their community, becoming part of the training team during the Africa-wide Processing and Value-Addition Task Force training of 565 women processors and 12 youths. This has led to the establishment of parboiling as a business to supply urban and rural markets. The processors of Malanville have also have seen the price of local parboiled rice rise — by 43%.

In Glazoué, output of parboiled rice has increased two-and-a-half times, while in Malanville, processing increased from zero to 25 tonnes in just 4 months. Moreover, a commercial rice importer from Cotonou is negotiating with the new businesses to buy their quality parboiled rice.

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The mayor of the commune of Malanville presenting an award to the representative of the women processor groups after the training on the use of the GEM parboiling technology

Tackling postharvest losses on a wide scale

Improving postharvest handling and processing of rice will reduce losses and increase the quality of local rice on the market. The ‘Support to rice research in Africa: Enhancing food security in Africa through the improvement of rice post-harvest handling, marketing and the development of new rice-based products’ project, funded by Global Affairs Canada (GAC), introduced small-scale machines, and trained local manufacturers to construct them.

The most popular machine is the ‘ASI’ axial-flow thresher–cleaner originally developed by AfricaRice in Senegal. Over the period January 2014 to March 2016, some 205 thresher–cleaners were made in 24 countries, by 108 artisans trained and supported by AfricaRice projects.

The GEM parboiling technology, originally developed by the Institute of Agricultural Research for Development (IRAD), Cameroon, and later adapted by AfricaRice and McGill University, is designed to enhance the quality of local rice. Evaluation of the

effect of adoption of GEM by rice-processors in Glazoué, Benin (published in 2015), showed that average monthly production increased by 188%, which converted into an increase in income of 123%. These increases are attributable to increases in the quality of the parboiled rice: heat damage reduced from 23.9% of grains to about 2%; whole grain content increased from 60% to 91%; undesirable chalky centers decreased from over 20% to zero; and impurities decreased from over 5% to zero.

About 660 people — men and women; researchers, technicians, extension agents, fabricators, processors and farmers — have been trained in rice postharvest operations. Moreover, some of these were trained as trainers, and the multiplier effect has seen over 6000 farmers, processors, artisans and traders trained by the project-trained trainers.

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A training session on use of the thresher–cleaner in Kano, Nigeria

Kick-starting mechanization communities of practice

The Africa-wide Rice Mechanization Task Force brings together 28 mechanization ‘champions’ representing both public and private sectors from 18 African countries.¹

Under the European Union–funded project ‘South–South collaboration on rice mechanization in Africa’, the task force conducted an inventory survey of agronomic and postharvest equipment in the rice-sector development hubs, using in-country experts with back-stopping from AfricaRice. This eventually fed into a mechanization needs assessment presented at the task force’s second meeting in February 2015 and forms the basis for proposing machines to fill the technology gaps in the hubs.

The Forum for Agricultural Research in Africa (FARA) established an online consultation to establish a mechanization platform for the Coalition for African Rice Development (CARD). The platform-cum-community

of practice now comprises 250 members in the form of an ‘open’ intercontinental public–private partnership (PPP) on agricultural mechanization.

Supported by the Global Forum on Agricultural Research (GFAR) and hosted by FARA, the PPP brings together mechanization stakeholders in Africa with counterparts in Asia and Latin America. It also provides a valuable link for the members of the mechanization task force.

These two communities of practice (the task force and the PPP) form the lasting legacy of the project, which ended in mid-2015; they will continue to support mechanization stakeholders on the continent for years to come.

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¹ For more details on the mechanization task force, see ‘Double boost for rice mechanization’, *AfricaRice annual report 2013*, pages 61–62.



The Thai power-tiller model in action, training session, Niono, Mali, May 2014

Strengthening the rice value chain through the Africa-wide rice task forces

International Fund for Agricultural Development (IFAD) support for the Africa-wide rice task forces continued through ‘Strengthening rice value chain in West and Central Africa’ in the Democratic Republic of Congo (DRC), Guinea, Senegal and Sierra Leone.

A number of promising varieties, identified through farmer-participatory varietal selection (PVS) conducted at three sites in the DRC by the Africa-wide Rice Breeding Task Force, are now progressing through the official release system. These should soon be available for rice farmers throughout the country. Meanwhile, the Sierra Leone Agricultural Research Institute, farmer associations and village communities are working together to produce quality seed of preferred adapted varieties to boost production in Sierra Leone.

AfricaRice and partners have taken advantage of the rapid development of information and communications technology (ICT) in sub-Saharan Africa, especially in the ‘cyber-seed’ system and ‘Remugol’ (see Box).

¹ See ‘GEM parboiling demonstrated as a cauldron for quality rice and revenue generation’, page 14.

Cyber-seed centers take data from national seed systems and make it available via ICT media, thereby linking smallholders — especially community-based seed producers — to the market. The cyber-seed system (www.semence.org) is being piloted in Côte d’Ivoire and Senegal.

Remugol involves private-sector actors as intermediaries: they collect information from rice cooperatives to send to millers who want to know where paddy stocks are available. They also collect information from millers to send to traders. Remugol (www.remugol.com) is being tested in the Senegal River valley in partnership with two public institutions and two private companies.

Through the Africa-wide Rice Mechanization Task Force, the project funded training in the construction of the ASI axial-flow thresher–cleaner in Senegal in collaboration with two other IFAD-funded projects that had joined as outscaling partners. This was the same training as provided elsewhere and at other times in Senegal and various other countries, demonstrating the value of ready-made technologies and support mechanisms (e.g. training materials) to speed outscaling.

Meanwhile, the Africa-wide Rice Processing and Value Addition Task Force introduced the GEM parboiling technology, including some fine-tuning of some of its components.¹

Any amount of quantity and quality upgrading is pointless if the farmers and processors cannot get their product to market. So, the project has linked farmers to marketing channels and markets through business-focused innovation platforms located within the hubs.

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Traditional grain sorting (Benin)

Supporting Nigeria's Agricultural Transformation Agenda

AfricaRice is supporting the Agricultural Transformation Agenda Support Programme Phase 1 (ATASP-1), which was developed by the African Development Bank (AfDB) and the Federal Ministry of Agriculture and Rural Development (FMARD) to contribute to food and nutrition security, employment generation and wealth creation along the cassava, rice and sorghum value chains in the wake of the Agricultural Transformation Agenda (ATA), which ended in 2015. ATASP-1 is expected to deliver 120,000 jobs along the three value chains, an additional 20,000 tonnes of the three commodities, and extensive training for youth in value-chain-related skills — all by early 2019.

AfricaRice is working in 27 local government areas (LGAs) in seven states — a vast rice-producing area with a population in excess of 32 million, most of whom are farmers.

Achievements in 2015 include the establishment of rice nurseries in 21 LGAs across the seven states. Despite challenges encountered due to flooding in the northwest during the growing season, affecting five LGAs, 17 rice demonstration farms (each composed of 16 rice varieties) were harvested and hosted farmer participatory varietal selection. ATASP-1 aims to

popularize at least three of the best performing rice varieties, as identified by major stakeholders (e.g. farmers, millers, consumers), in four zones. Five of the 16 varieties demonstrated (FARO 44, 52 [WITA 4], 57, 60 [NERICA-L 19] and 61 [NERICA-L 34]) were released and introduced during the ATA but others are new to the farmers. Six new varieties (ART series) developed mainly for flood/submergence tolerance have yet to be released. Average farm-level yields of these varieties ranged from 3.7 to 5.8 t/ha, but the best yielded well above 6 t/ha in some locations.

A rapid assessment of stakeholders' current paddy production practices and constraints, level of technology integration, yields and income was conducted to determine knowledge and yield gaps, and subsequently to identify actors for engagement in each zone. Market linkages among major actors and their constraints were also mapped. In 2016, those identified will be sensitized and engaged at different links in the value chain to build their capacity, integrate technology to improve productivity and efficiency, and develop market linkages and entrepreneurship.

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Rice demonstration plots at Kafin Housa village, Kafin Housa LGA, Jigawa State

A novel business model to engage youth to scale up technology adoption

In a drive to make ‘scalable technologies’ available beyond the hubs, the AfricaRice knowledge management unit developed an operational mechanism — the Framework for Innovation in the Food Sector (FIFS) — a ‘one-stop shop’ for farmers for innovation and business support services. The framework was developed under the project ‘Catalyzing the adoption and use of scalable technologies in Africa’ (CAUSA), funded by the German Federal Ministry for Economic Cooperation and Development (BMZ).

A core component of the FIFS is the Rural Universe Network (RUN)¹ business model — a result-oriented, demand-driven model that turns funding on its head. “Instead of funding service providers, we establish a ‘service fund’, which value-chain actors can draw upon to buy services,” says head of unit Marc Bernard. A key service is the information exchange service.

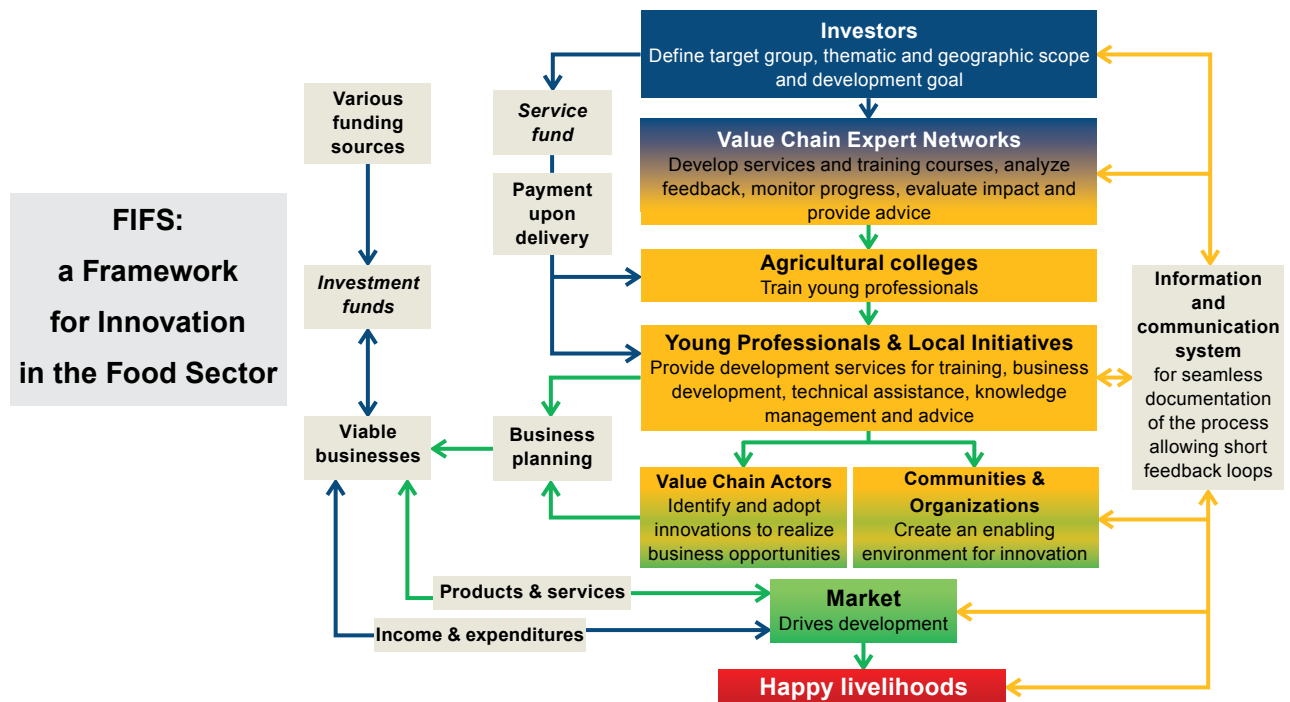
A field agent posts the end-user’s question, which is then picked up by a ‘knowledge broker’ who feeds it through to an appropriate expert to provide an answer. The service providers are then paid from the service fund once the end-user is happy with the response. To conceptualize services FIFS draws on a continental network of rice experts.

AfricaRice-trained lecturers at colleges train graduates as service providers, who are then mentored for 2 years. Thus was born the first generation of service providers and the first innovation support-service businesses.

FIFS operates in 16 communities *outside of the hubs* in four countries. It ties together many activities of AfricaRice and provides a mechanism for young professionals to establish a business, making a living from providing valuable services to rural communities.

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¹ See <https://wiki.africarice.net/display/GIAE/The+RUN+business+model>



Research and innovation highlights

Rehabilitating the rice sector in post-conflict countries

Liberia and Sierra Leone are still recovering from civil wars that ended in the early 2000s.

AfricaRice staff posted to these countries are helping to rebuild the rice sector within the context of the West Africa Agricultural Productivity Program (WAAPP), funded by countries implementing the program, with facilitation by the World Bank and the West and Central African Council for Research and Development (WECARD/CORAF).

AfricaRice helped to purify old varieties that had become mixed up, and introduced new varieties. By the end of 2015, six lowland and four upland varieties had been successfully introduced to farmers in Liberia. While seven upland varieties were released and five lowland and mangrove-swamp varieties were cleared for release in Sierra Leone.

The Program partners — the Economic Community of West African States (ECOWAS), the World Bank, WAAPP, the West Africa Seed Program (WASP) and WECARD/CORAF — launched Initiative Ebola, which provided huge quantities of seed to the needy farmers, who had been forced to eat their own grain reserves and seed stocks to avoid starvation when large areas were quarantined.

Under the ‘Ebola Initiative’, AfricaRice facilitated the import of Certified and Foundation seed of popular upland and lowland NERICA varieties into Guinea, Liberia and Sierra Leone from other countries in the region. The Certified seed was immediately distributed to vulnerable farmers, while the Foundation seed was used to produce Certified seed by out-growers trained by AfricaRice.

The major seed-producing cooperative in Gbedin, Nimba County, Liberia, expanded from 91 members

producing about 50 tonnes of Certified seed in 2014 to 250 farmers producing in excess of 350 t of Certified seed in 2015.

AfricaRice also introduced the Smart-valleys approach for low-cost land and water management¹ in Liberia. Despite interruption of the action-research by the Ebola outbreak, some farmers have adopted the system.

AfricaRice and Sierra Leone Agricultural Research Institute’s Rokupr Agricultural Research Centre completed a survey and analysis of the rice value chain to understand its structure, functioning and key features — including strengths and weaknesses of key actors and their linkages, costs and returns by product and actor, and constraints and opportunities throughout the value chain — and developed an action plan for upgrading the value chain.

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¹ See ‘Working with farmers to improve water control in inland valleys’, *AfricaRice annual report 2013*, pages 14–16, and ‘Smart-valleys’, *AfricaRice annual report 2014*, pages 32–34.

Improving rice production information in Africa

Crop production statistics are essential information for assessing the food-security situation but they are notoriously difficult to collect. In 2013, the Japanese Ministry of Agriculture, Forestry and Fisheries (MAFF) funded a 3-year pilot project, ‘Improving food security information in Africa’.

To improve the accuracy and timely release of rice statistics for Africa, AfricaRice adopted a method combining ‘dot sampling with Google Earth’ and ‘crop cutting’, developed in Japan, and adapted to African conditions.

The method has been tested in six countries: Benin, Burkina Faso, Ethiopia, Madagascar, Nigeria and Senegal. Over 350 national researchers and statisticians (21% of them women) from 26 (AfricaRice and Coalition for African Rice Development member) countries have been trained in the various components of the dot sampling method and also on the use of the Mlax data-collection and analysis application.¹

National teams are enthusiastic about the improved method. Minilik Tsega, statistician in the Agricultural Economics, Extension and Gender Research Directorate of the Ethiopian Institute of Agricultural Research said, “I am convinced that the dot sampling method has the capacity to produce reliable planted area estimates in relatively short period of time and [at] minimum cost; can be a better option to produce area and production estimates for rare crops [such as] rice in Ethiopia, which are not well represented in annual agricultural surveys. [It] can be a quick fix to produce local level production and area statistics, which usually we don’t get from national level surveys.” With such attitudes, it seems likely that the dot sampling method will be adopted widely.

AfricaRice impact assessment economist and project coordinator Aminou Arouna says, “The dot sampling

method is easily applied and requires fewer resources than other methods. In addition, the increasing availability of satellite images of high quality and spatial images using drones or remotely piloted aerial systems, create new opportunities for the use of the dot sampling method for improving rice statistics and food security in Africa.”

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Practical exercise during the 2015 training of national partners and enumerators on dot sampling methods (Farakoba, Bobo-Dioulasso, Burkina Faso)

¹ www.mlax.org

Finance

Statements of activity (expressed in thousands of US\$)

	Total 2015	Total 2014
Revenue and gains		
Grant revenue		
Windows 1 and 2	5,804	10,198
Window 3	2,796	7,954
Bilateral	14,006	10,416
Total grant revenue	22,606	28,568
Other revenue and gains	453	630
Total revenue and gains	23,059	29,198
Expenses and losses		
Research expenses	17,877	21,547
CGIAR collaboration expenses	219	238
Non-CGIAR collaboration expenses	2,695	4,745
General and administration expenses	4,186	1,817
Other expenses and losses	–	–
Total operating expenses	24,977	28,347
Financial income	(23)	(77)
Financial expenses	572	885
Surplus (Deficit)	(2,467)	43

List of donors

AfricaRice sincerely thanks all the donors who have generously contributed to its success:

- AfricaRice Member States
- African Development Bank (AfDB)
- Arab Bank for Economic Development in Africa (BADEA)
- Bill & Melinda Gates Foundation
- Centre de coopération internationale en recherche agronomique pour le développement (CIRAD, French agricultural research and international cooperation organization)
- CGIAR Generation Challenge Programme (CGIAR GCP)
- CGIAR Research Program on Climate Change, Agriculture and Food Security (CGIAR CCAFS)
- Côte d'Ivoire Government
- The Crop Trust
- Department for International Development, UK (DFID)
- Economic Community of West African States (ECOWAS/CEDEAO)
- European Union (EU)
- Food and Agriculture Organization of the United Nations (FAO)
- Federal Ministry for Economic Cooperation and Development, Germany (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung, BMZ)
- Global Affairs Canada (GAC)
- Global Rice Science Partnership (GRiSP, CGIAR Research Program on Rice)
- Institut de recherche pour le développement (IRD, French research institute for development)
- International Fund for Agricultural Development (IFAD)
- Japan (JICA, JIRCAS, MAFF, MOF, MOFA)
- Liberia Government (World Bank-WAAPP, AfDB-SAPEC)
- Nebraska University, USA
- Netherlands Organisation for Scientific Research (NWO-WOTRO)
- Nigeria Federal Government
- Rural Development Administration, Korea (RDA)
- Sierra Leone Government (World Bank-WAAPP)
- Syngenta Foundation for Sustainable Agriculture (SFSA)
- United States Agency for International Development (USAID)
- University of Sheffield, UK
- West African Economic and Monetary Union (UEMOA)
- West and Central African Council for Agricultural Research and Development (WECARD/CORAF)

Partnerships

As an Association of member states, AfricaRice's basic modus operandi is partnership at all levels with other stakeholders. These rice stakeholders range from global and regional organizations with an interest in and influence on agriculture in Africa, to African farmers and other rice value-chain actors.

Here we present some highlights from 2015 from our Division of Strategic Partnerships.

Regional economic communities

AfricaRice's partnership base continued to expand in 2015 to include non-traditional partners such as regional economic communities, the private sector and sub-regional and regional organizations involved in agricultural research and development in Africa. The Center signed a 5-year memorandum of understanding (MoU) with the **Economic Community of West African States (ECOWAS)** in February, making the Center a scientific and technical partner in the implementation of ECOWAP, the Regional Agricultural Policy for West Africa. AfricaRice is a member of the Technical Support Group for ECOWAP, contributing to (1) the implementation of the Regional Rice Offensive, which seeks to achieve self-sufficiency in rice production in West Africa by 2025; (2) the development of innovative mechanisms for sustainable financing of agricultural research through the World Bank-funded West Africa Agricultural Productivity Program (WAAPP); and (3) the implementation of a common external tariff for the ECOWAS region.

AfricaRice engages with the **West African Economic and Monetary Union (UEMOA)** in a project to relaunch the rice sector in West Africa, and UEMOA has provided support for the purchase of scientific equipment for the AfricaRice Regional Training Center in Saint-Louis, Senegal, which it considers a center of excellence.

In 2015, AfricaRice visited the **Economic Community of Central African States (ECCAS)**, to work toward the signing of an MoU with ECCAS, similar to that with ECOWAS. This partnership should help to leverage a Central Africa Agricultural Productivity Program (CAAPP) similar to WAAPP.

Private sector

Partnership with the private sector, commonly referred to as public-private partnerships (PPPs), is exemplified by AfricaRice and the **Syngenta Foundation for Sustainable Agriculture (SFSA)** establishing a grant agreement to fill the position of a seed systems development coordinator. SFSA, a private not-for-profit organization based in Switzerland, is developing an MoU for future collaboration in the areas of seeds, rice value chains, organoleptic tests, mechanization, RiceAdvice¹ and demand-led breeding.

Grow Africa is a network of partners — including international and domestic private-sector companies, public-sector organizations, farmer organizations, service providers, financiers, development organizations and NGOs — working to increase responsible private-sector investment in agriculture, and accelerate the execution and impact of investment commitments on smallholder farmers. AfricaRice took part in a working session with the initiative on rice variety matrix (commercial use of rice varieties), innovation platforms for capacity-strengthening, and more private-sector demand-driven programs.

Universities

The **West Africa Centre for Crop Improvement (WACCI)** of the **University of Ghana** has the largest PhD program in plant breeding in West Africa. AfricaRice engages with WACCI in fellowships, joint academic supervision and student placement, and exchange of breeders (sabbaticals). Several WACCI students working toward their PhD degrees are being supervised by AfricaRice scientists and are attached to AfricaRice for their fieldwork.

AfricaRice and the **Agricultural University of Ketou, Benin**, signed a new MoU and action plan in August. UAC is training young professionals as service providers under the ‘Catalyzing the adoption and use of scalable technologies in Africa’ (CAUSA) project (*see* page 19).

Regional and sub-regional organizations

AfricaRice and the **Forum for Agricultural Research in Africa (FARA)** collaborate in the mechanization-based South–South collaboration project under the Coalition for African Rice Development (CARD) (*see* page 16).

Other agreements signed

In addition to those already mentioned, AfricaRice signed an MoU with the **Competitive African Rice Initiative (CARI)** in 2015 for widespread testing and out-scaling of RiceAdvice.

AfricaRice also signed new grant agreements with the **Federal Ministry for Economic Cooperation and Development (BMZ)** and **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)** for the establishment of a Green Innovation Centre in Cotonou, Benin.

Country level

AfricaRice is of course extremely active with partners in member (and would-be member) countries.

In 2015, AfricaRice followed up calls from its Council of Ministers to establish a regional rice research station in Central Africa by investigating the possibility of establishing an office in the **Democratic Republic of Congo**, with assistance from the International Fund for Agricultural Development (IFAD) and the World Bank.

Work continued on negotiations with **Tanzanian** Government authorities for the country to become an AfricaRice Member State, including the drafting of a cabinet paper.

¹ RiceAdvice is an Android-based decision-support tool for providing farmers with pre-season field-specific nutrient management guidelines for rice production systems in Africa.

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* Joined in 2015.

‡ Left in 2015.



Training

AfricaRice training program (courses)



44 Training courses run in 2015



18 Locations



in **8** countries



597 Total trainees

Postgraduate trainees



24 Total female postgrads



54 Total male postgrads



From **24** countries



48 PhD students

... of whom



14 female



34 male



30 MSc students

... of whom



10 female



20 male



With **40** universities



in **18** countries



21 Funding sources

Publications 2015

AfricaRice publications 2015



50 Articles in Thomson Reuters-list journals



10 Articles in other peer-reviewed journals



7 Book chapters



12 Conference papers



6 Articles in *Rice Today*



2 Others / reports



5 Videos
... in **5** languages

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Abbreviations

ADRAO	Association pour le développement de la riziculture en Afrique de l’Ouest (<i>former French name of AfricaRice</i>)
AfDB	African Development Bank
AfricaRice	Africa Rice Center
ASI	ADRAO–SAED–ISRA thresher–cleaner
ATA	Agricultural Transformation Agenda (Nigeria)
ATASP	Agricultural Transformation Agenda Support Program (Nigeria)
BADEA	Arab Bank for Economic Development in Africa
BBSRC	Biotechnology and Biological Sciences Research Council (UK)
BMZ	Federal Ministry for Economic Cooperation and Development (Germany)
CAADP	Comprehensive Africa Agriculture Development Programme
CAAPP	Central Africa Agricultural Productivity Program
CARD	Coalition for African Rice Development
CARI	Central Agricultural Research Institute (Liberia)
CARI	Comprehensive African Rice Initiative
CAUSA	Catalyzing the adoption and use of scalable technologies in Africa (project)
CCAFS	Climate Change, Agriculture and Food Security (CRP)
CCC	crop calendar construction (model)
CEDEAO	Communauté Économique Des États de l’Afrique de l’Ouest (<i>French abbreviation for ECOWAS</i>)
CEMAC	Commission de la communauté économique et monétaire de l’Afrique central
CFA	local currency of countries in CEMAC and UEMOA
CIAT	International Center for Tropical Agriculture
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (France)
CRP	CGIAR Research Program
DFID	Department for International Development (UK)
DRC	Democratic Republic of Congo
ECCAS	Economic Community of Central African States
ECOWAP	Regional Agricultural Policy for West Africa
ECOWAS	Economic Community of West African States
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FIFS	Framework for Innovation in the Food Sector
FMARD	Federal Ministry of Agriculture and Rural Development (Nigeria)
FOFIFA	Centre National de Recherche Appliquée au Développement Rural (Madagascar)
GAC	Global Affairs Canada
GCP	Generation Challenge Program (CGIAR)
GFAR	Global Forum on Agricultural Research
GIS	geographic information systems

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRiSP	Global Rice Science Partnership (Rice CRP)
Icipe	International Centre of Insect Physiology and Ecology
ICT	information and communications technology
IFAD	International Fund for Agricultural Development
IFDC	<i>formerly known as</i> International Fertilizer Development Center
IITA	International Institute of Tropical Agriculture
INRAB	Institut national de recherches agricoles du Bénin
IP	innovation platform
IPCC	Intergovernmental Panel on Climate Change
IRAD	Institute of Agricultural Research for Development (Cameroon)
IRD	Institut de recherche pour le développement (France)
ISBN	International Standard Book Number
ISRA	Institut sénégalais de recherches agricoles (Senegal)
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agricultural Sciences
LGA	local government area (Nigeria)
MAFF	Ministry of Agriculture, Forestry and Fisheries (Japan)
MOF	Ministry of Finance Japan
MOFA	Ministry of Foreign Affairs of Japan
MoU	memorandum of understanding
MSc	Master of Science (postgraduate degree)
NCGRP	National Center for Genetic Resources Preservation (USA)
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
No.	number (of)
NWO-WOTRO	Netherlands Organisation for Scientific Research – Research for Global Development
PhD	Doctor of Philosophy (doctoral degree)
pp.	pages
PPP	public–private partnership
pv.	pathovar
PVS	participatory varietal selection
RCP	Representative Concentration Pathway
RDA	Rural Development Authority (Korea)
RUN	Rural Universe Network
RYMV	<i>Rice yellow mottle virus</i>
SAED	Société d’Aménagement et d’Exploitation des terres du Delta et des vallées du fleuve Sénégal et de la Falémé (Senegal)

SAPEC	Smallholder Agricultural Productivity Enhancement and Commercialization (AfDB project, Liberia)
SARD-SC	Multinational CGIAR Support to Agricultural Research for Development on Strategic Commodities in Africa (project)
SFSA	Syngenta Foundation for Sustainable Agriculture
SLARI	Sierra Leone Agricultural Research Institute
sp.	(unspecified) species (singular)
STRASA	Stress Tolerant Rice for Poor Farmers in Africa and South Asia (project)
StRiGA	<i>Striga</i> resistance genes for Africa (project)
Tmax	maximum temperature
UEMOA	West African Economic and Monetary Union (Union Économique et Monétaire Ouest Africaine)
UK	United Kingdom (of Great Britain and Northern Ireland)
US	United States
USA	United States of America
USAID	United States Agency for International Development
WAAPP	West Africa Agricultural Productivity Program (World Bank)
WECARD/CORAF	West and Central African Council for Research and Development
WACCI	West Africa Centre for Crop Improvement (University of Ghana, Legon)

About CGIAR

CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources and ecosystem services. Its research is carried out by 15 CGIAR Centers in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector.

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The Centers

AfricaRice	Africa Rice Center (Abidjan, Côte d'Ivoire)
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)



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