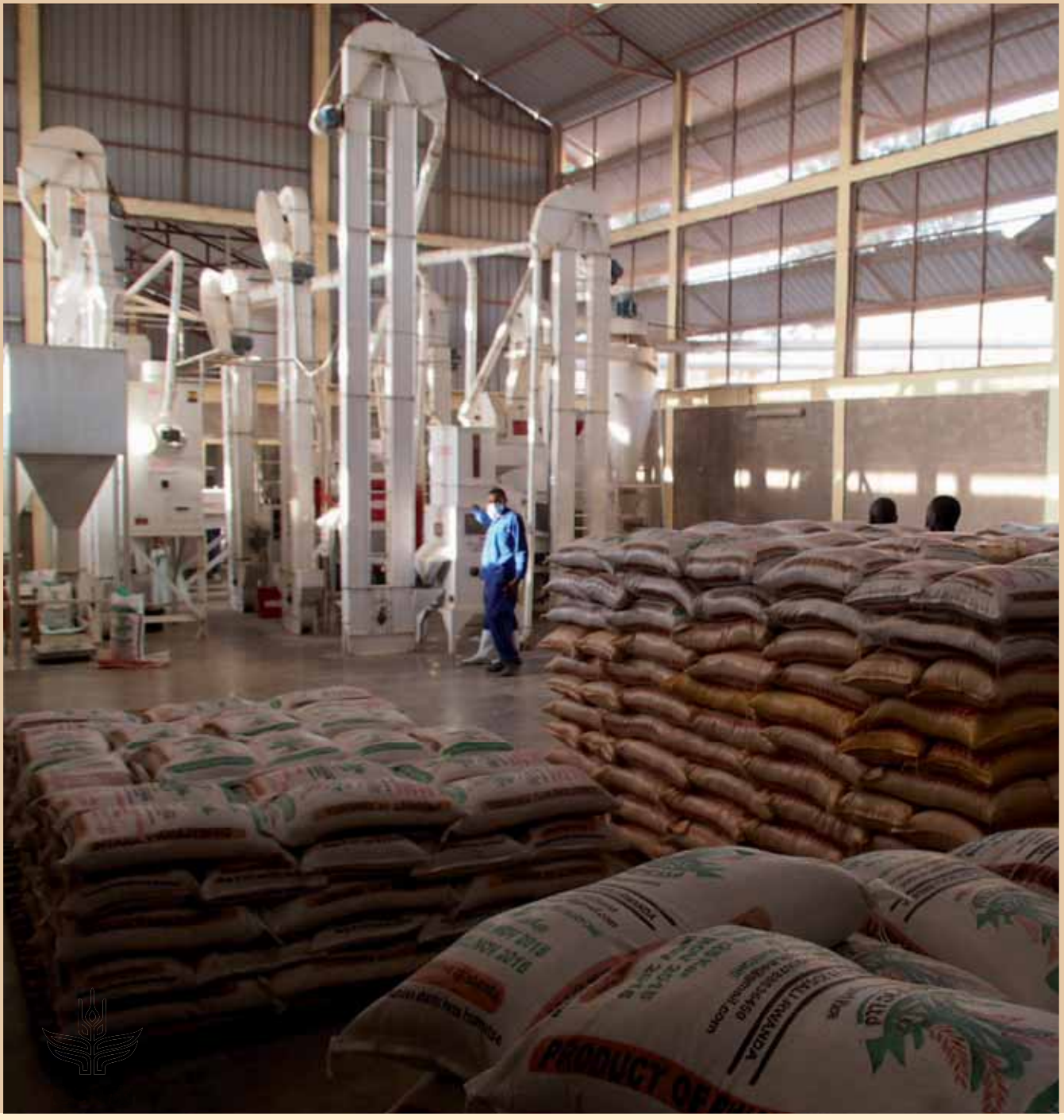

AfricaRice

Towards rice self-sufficiency in Africa

Africa Rice Center (AfricaRice) – Annual Report 2016

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All pictures are by staff members of Africa Rice Center, and networks and consortia convened by the Center.

Cover: Modern rice mills, such as the Mukunguri Rice Mill in Kamonyi District, Southern Province, Rwanda, play an important role in national rice development programs.

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.

Contents

AfricaRice

Message from the Board Chair and Director General

Now more than ever, AfricaRice considers its contribution to realize the vision of African Heads of States of rice self-sufficiency and reducing the huge rice import bills in Africa, unique. AfricaRice continues its mission as a center of excellence for rice research, development and capacity-strengthening, to deliver knowledge products and services to stakeholders of the rice value chain in Africa in order to realize the rice promise.

Strategic developments

In March, the Board of Trustees (BoT) approved a new partnership strategy, which reaffirms AfricaRice's modus operandi of 'partnership at all levels' and defines the purpose of the partnership strategy as "to deliver on the objectives of [the] 2011–2020 Strategic Plan" (for more details, *see* 'Partnerships', page 25). A Capacity Development Unit was created that will not only ensure the usual strengthening of the capacity of rice value-chain actors through training, but will also put emphasis on measuring the impact of training on the development of the rice sector (*see* 'Capacity development', page 23).

August saw the organization of the biennial meeting of the Council of Ministers (CoM) of AfricaRice, in Kampala, Uganda, with the presence of representatives of 14 member states. Representatives of Ethiopia and South Africa attended as observers. The Ministers

Chair of the Board of Trustees, Prof. Em. Dr Ir. Eric Tollens (right), with Director General, Dr Harold Roy-Macauley

were pleased to welcome Ethiopia into the fold during the meeting, thus bringing the total number of member countries to 26. The Ethiopian State Minister of Agriculture and Natural Resources, Hon. Wondirad Mandefro, responded: "We look forward to the scientific support and technical expertise that AfricaRice offers to its member countries, which will help Ethiopia achieve its rice-sector development targets." During this meeting, the Chair of the CoM passed to Senegal with the Minister of Agriculture and Rural Equipment and former AfricaRice Director General, Dr Papa Abdoulaye Seck, assuming the position of Chair.

In November, and for the first time in the history of AfricaRice, the Chair of the CoM carried out a working visit to the offices of AfricaRice in Abidjan, Côte d'Ivoire. Dr Seck worked with Management to lay out an action plan for his tenure. During this visit, the CoM Chair, accompanied by the Director General, paid courtesy calls to the Minister of Agriculture and Rural Development (Hon. Mamadou Sangafowa Coulibaly), Minister of African Integration and Ivorians Overseas (Hon. Ally Coulibaly), as well as to the President of the African Development Bank (AfDB), Dr Akinwumi Adesina. During the meeting with the AfDB President, it was agreed that AfricaRice would lead the development of a Continental Investment Plan for Accelerating Rice Self-Sufficiency in Africa (CIPRiSSA) (*see* 'Policy support for accelerating rice self-sufficiency in Africa', page 7).

The relocation of the Headquarters and many Cotonou-based staff to Côte d'Ivoire was pursued. By the end of the year, 104 staff members, constituting more than a third of all staff, were based in Côte d'Ivoire. This includes 53 staff based at Bouaké and working at the M'bé station, some of whom, however, were there throughout the Ivorian crises. The management of the Cotonou research station was returned to its owner, the International Institute of Tropical Agriculture (IITA), in December, based on a formal agreement signed between the two institutions. AfricaRice considers Benin as a country station.

New faces on the management team

In April, a new Director of Corporate Services, Mr Koen Geerts, was appointed. Koen brings almost 40 years' experience in corporate services gained from working in various CGIAR entities in Africa, Europe and the Middle East. His early days at AfricaRice were focused on the challenges encountered by AfricaRice in the areas of finance and budgeting.

In July, we were pleased to announce the appointment of our new Deputy Director General and Director of Research for Development, Dr Etienne Duveiller. He took up office on 1 September. Etienne was formerly Regional Representative for Asia and Director of Research for South Asia of the International Maize and Wheat Improvement Center (CIMMYT). He brings to AfricaRice a wealth of research leadership experience, having spent more than 30 years working in Latin America, Asia and Africa. One of his main strengths is in sustainable development, which is a key to the development of the rice sector in Africa.

Research-for-development activities

The year's activities covered the full spectrum of research-for-development, from 'big picture' policy through 'discovery' research, product design–development–delivery, to empowering value-chain actors. Highlights of resulting knowledge products captured in this report include best-bet estimates on the distribution and economic impact of parasitic weeds on rice in Africa, salt-tolerant rice cultivars, AfricaRice's first hybrid rice cultivars selected for release in Senegal, Smart-valleys approach to lowland development, RiceAdvice decision-support app, GEM parboiling technology and knowledge base for R&D practitioners to help them design better-targeted approaches to women farmers. We believe that these products are poised to create significant impact in the future and we hope that you find them as inspiring as we do.

In January, the German Federal Minister for Economic Cooperation and Development, Hon. Gerd Müller, inaugurated a Green Innovation Center (GIC) at our Benin station. This Center was established under a special initiative of the German Federal Ministry for Economic Cooperation and Development (BMZ), which aims at creating 13 Green Innovation Centers across the globe, designed to promote innovation in the agriculture and food sectors to combat rural poverty and hunger. The focus of the Cotonou-based GIC is boosting agricultural productivity, increasing incomes of stakeholders and processors, and creating jobs, especially for youth and women in Benin. Increasing the performance of the rice value chain is a major activity of the GIC in Benin.

In May, the AfricaRice regional training center for rice value-chain actors, situated in Saint-Louis, Senegal, was inaugurated by the Minister of Agriculture and Rural Equipment of Senegal, Dr Papa Abdoulaye Seck, in the presence of the AfricaRice Board Chair, Director General and staff members, as well as local authorities, donors and partners. This Training Center was established by AfricaRice with support from the Government of Senegal, African Development Bank (AfDB) and the West African Economic and Monetary Union (UEMOA). Africa has an estimated 200 million young people aged 15 to 24 years.

While this number is expected to double by 2045, it is estimated that the growing rice sector on the continent could potentially employ many of these young people. The availability of world-class facilities on the continent to train upcoming generations of rice farmers and other value-chain actors, rice researcher and development agents, is, therefore, of vital importance. The AfricaRice facility in Saint-Louis has a 100-seat conference hall and two training halls with capacity for 25 trainees each. It also has accommodation for 40 residential trainees and 6 trainers.

New breeding activities geared towards accelerating the development of a new generation of productive and stress-tolerant rice varieties for Africa from crosses between elite NERICA and ARICA varieties and Korean germplasm ('Tongil' *indica–japonica* material) were initiated with the signing, in October, of a Memorandum of Understanding and an agreement with the Korean Rural Development Administration (RDA) and the Korea–Africa Food and Agriculture Cooperation Initiative (KAFACI). This event also marked the launching of a new strategic partnership that allows Africa to draw on the experience and knowledge of the Republic of Korea.

A Korean rice breeder will be seconded to AfricaRice to work with an AfricaRice breeder. Rice breeders from the national programs continued to benefit from training provided under a pilot project that started in 2015. The agreement signed will facilitate the establishment of an anther-culture laboratory at the AfricaRice Sahel station in Senegal. The agreement will cover activities in 20 African countries and will also support seed dissemination.

The end of the year saw the phasing out of the Global Rice Science Partnership (GRiSP) as a CGIAR Research Program (CRP), under which much of the research work of AfricaRice has been conducted since 2011. An independent evaluation of GRiSP in 2015 is summarized in the following words of the evaluators:

> *GRiSP has succeeded in significantly increasing the interaction and synergies between the six core partners. GRiSP has provided a global framework for setting a shared agenda for rice research, thinking about impact pathways, and developing collaborative research on globally important challenges for the rice sector.*

The phasing out of the GRiSP CRP does not, however, mean an end to CGIAR-coordinated rice research. In January 2017, the GRiSP CRP transitioned smoothly into the Rice Agri-food Systems (RICE) CRP, which builds on lessons learned from GRiSP. GRiSP does, however, still exist as a partnership mechanism, and work is ongoing with the International Rice Research Institute (IRRI) to define its new modus operandi.

Africa 'riceing'

The Director General of AfricaRice presented evidence-based strategies for reaching rice self-sufficiency in Africa, and the value of investing in rice research and innovation as a pathway to this, at a number of high-profile international events.

These included a highlight address on rice at the Forum for Agricultural Research in Africa (FARA) African Agriculture Science Week and General Assembly in Kigali; presentations at side-events (organized by the Coalition for African Rice Development (CARD); the World Bank) during the sixth Tokyo International Conference on African Development (TICAD VI) in Nairobi; participation in a roundtable on rice self-sufficiency in Africa at a side-event at the 14th International Symposium on Rice Functional Genomics (ISRFG) in Montpellier; presentation at a ministerial meeting on Adaptation of Africa's Agriculture to Climate Change ('Triple A') in Casablanca, which provided input to the 22nd Conference of the Parties to the United Nations Framework Convention on Climate Change (COP22); and participation in a roundtable discussion at the Third Edition of the Agra Innovate West Africa Conference in Lagos.

The presentations made also highlighted the need for appropriate policy measures to enhance the competitiveness of the rice value chain (*see also* 'Policy support for accelerating rice self-sufficiency in Africa', page 7).

High-profile visitors in 2016

As ever, the undeniable importance of rice in Africa led to a number of high-profile visitors passing through our doors, including the following: the Minister of Agriculture, Forestry and Food Security of Sierra Leone; the Commissioner for Agriculture and Rural Development of the African Union Commission (AUC); the Commissioner of Agriculture and Rural Development and Director of Agriculture of the Economic Community of West African States (ECOWAS); the Honorary President of the Farmers and Producers Organization for West Africa; the Minister of Agriculture, Livestock and Fisheries of Benin; the Minister of Agriculture of France; the World Bank Country Director for Benin, Burkina Faso, Côte d'Ivoire and Togo; the West Africa Regional Representative of the International Fund for Agricultural Development (IFAD); the former Interim Director General of AfricaRice; the Ambassador and First Secretary of the Belgian Embassy in Côte d'Ivoire; and the Mayor of Bouaké.

Finance and fundraising

Significant and unpredictable reductions in CGIAR funding remain a major financial challenge encountered for the Center. This manifested itself as a budget deficit at the end of the year and loss of reserve-days (*see* 'Finance', page 28).

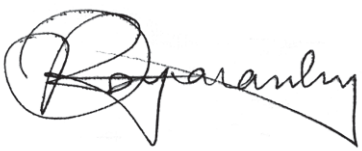
In the quest of increasing its revenue to overcome these challenges, a new fundraising strategy with a rolling 3-year resource-mobilization plan was developed. Major elements of the strategy comprise full cost-recovery of services provided to projects and partners, recovery of Member State arrears, and intensified interaction by the Director General with donors and partners. Consequently, the Director General visited a number of Member States, and raised the 'thorny' issue of Member State contributions and arrears, pleading to them to respect their statutory obligations.

Still under the banner of advocacy and fundraising, the Director General and other senior members of staff also met with key funding and research partners, including BMZ–Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ); Syngenta Foundation for Sustainable Agriculture; Office Chérifien de Phosphates (OCP); IFAD; AUC; ECOWAS; the World Bank; a delegation from the RDA of the Republic of Korea; the Belgian Ambassador to Côte d'Ivoire; and the Islamic Development Bank (IsDB).

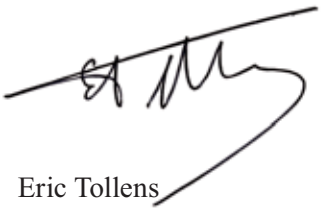
CGIAR

The CGIAR pursued its reform process. Both the Board Chair and the Director General participated in the development and validation of reports and legal documents related to the CGIAR transition process. These eventually ended with the dissolution of the CGIAR Consortium and its replacement by the CGIAR System Organization, with two governing bodies: the CGIAR System Council (funders) and the CGIAR System Management Board (independent members, Center Board members and Directors General).

We still have a big task ahead of us of remodeling AfricaRice to fulfill its amazing vision of the rice promise and we are confident of a change in fortunes for the funding of rice research for development in Africa, in the foreseeable future. We are determined and still have big dreams and ambitions. For this, we are very grateful that we have so many loyal friends along the road with whom we travel together. Thank you!



Harold Roy-Macauley



Eric Tollens

The AfricaRice regional training center for rice value-chain actors, situated in Saint-Louis, Senegal, was inaugurated on 7 May 2016 by the Minister of Agriculture and Rural Equipment of Senegal, Dr Papa Abdoulaye Seck, in the presence of the AfricaRice Board Chair, Director General and staff members, as well as local authorities, donors and partners. The training center was set up with strong support from the Government of Senegal, the African Development Bank (AfDB) and the West African Economic and Monetary Union (UEMOA). AfricaRice is adopting a new strategy to professionalize the full range of actors in the rice value chain. The new training center aims to strengthen the technical capacity of the rice value chain actors in Africa. In addition to thematic courses on rice production, specialized modules that promote entrepreneurship and agribusiness will be offered to participants to help them develop profitable and competitive rice enterprises

Policy support for accelerating rice self-sufficiency in Africa

Demand for rice in Africa continues to surpass local production. Twenty-two of the 43 rice-producing countries in Africa are experiencing growing demand for rice. These countries consequently import 10–90% of their rice needs, estimated at a cost of over US$ 5.5 billion per year.

Rice sector policies focus mainly on improving production (area and productivity), with less attention to demand factors and markets. However, the physical quality of rice produced locally often fails to match urban preferences, which have been shaped by imported brands characterized by their cleanliness, appearance and head-rice ratio (percentage of whole grains). Even Mali, the country with the highest self-sufficiency ratio, has large amounts of imported rice in its urban markets. In effect, Koutiala and Sikasso, which are both over 13,000 km from the nearest port in West Africa, have more than 40% imported rice on their markets. Yet there is great potential for local rice, if its quality can demonstrably match that of imported brands.

AfricaRice has, over time, made broad policy recommendations geared toward boosting the rice sector in Africa, which currently take a three-pronged approach as described below.

- First, it is necessary to increase local production through both area expansion and productivity enhancements.
- Second, "It is vital that we increase the competitiveness of local rice vis-à-vis imported brands," says AfricaRice agricultural economist Rose Fiamohe. "This means growing rice cultivars with similar characteristics to imported rice, in terms of shape, head-rice ratio, texture and swelling capacity; introducing improved harvesting and postharvest facilities, equipment and innovations especially for milling, cleaning and grading; and then de-differentiating quality local rice from imported brands via branding, labelling and marketing."
- Third, AfricaRice, national governments and regional institutions need to identify policy instruments to finance upgrading of the domestic rice sector on a country-by-country basis.

In 2016, AfricaRice and the African Development Bank (AfDB) established an 8-year rice development

There is often stark contrast between the ways in which imported rice brands (left) and local rice (right) are marketed: bright bags with memorable logos versus generic white sacks with basic printing

investment plan (2018–2025) dubbed the Continental Investment Plan for accelerating Rice Self-Sufficiency in Africa (CIPRiSSA). Focusing on the rice value chain, this plan will be country-specific. Development of the plan has been initiated with the following countries which all have high rice production and consumption and which are also capable of supplying the totality of the quantity of rice need by Africa: Cameroon, Côte d'Ivoire, Madagascar, Mali, Nigeria, Senegal, Sierra Leone, Tanzania and Uganda.

CIPRiSSA defines how AfricaRice, AfDB and the nine project countries will move the rice industry from its present status to where it needs to be by 2025. CIPRiSSA estimates that, across the nine countries, the annual investment in the rice sector needs to be US$ 183.7–213.4 million, hence a total investment of $1.6 billion by 2025. Against this investment, cumulative foreign exchange savings from reduced rice imports are estimated at US$ 2.4 billion for the nine countries. These countries are expected to become rice self-sufficient by 2025 and to produce surpluses for export.

The successful rolling out of CIPRiSSA in these nine countries will allow the scaling out of lessons learned, principles, strategies and mechanisms to other African countries.

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Rice is fast becoming the preferred food in many sub-Saharan African countries

How important are parasitic weeds in African rice?

Many people, including weed scientists who work on other cereals, are surprised to learn that parasitic weeds are a problem for rice in Africa. Just how much of a problem are they?

AfricaRice has been carrying out research on the four main parasitic weeds of rice — *Rhamphicarpa fistulosa*, *Striga asiatica*, *S. aspera* and *S. hermonthica*. Of the four weeds, *Rhamphicarpa* has received the least attention; before AfricaRice research on parasitic weeds resumed in 2007, the last academic paper published on *Rhamphicarpa* was in 1999.[1] Research on *Striga* on rice, unlike on maize and other dryland cereals, has also received little attention.

With very little information available, an AfricaRice multidisciplinary team was determined to find out just how much of a problem these weeds really are in rice crops. "We had to think about a methodology to help answer these questions very carefully," says AfricaRice agronomist Jonne Rodenburg.

Three sources of weed-distribution data identified — publicly accessible herbarium databases; published literature; and personal observations by AfricaRice staff during field missions. These yielded over 2200 data points, which were geo-referenced using Google Earth (*see opposite page*).

Data on rainfed rice area were taken from the two best available data sets. Economic assessment of crop losses to parasitic weeds was carried out based on areas of overlap between weed species and rainfed rice area, and published yield-loss data. The model developed from this study revealed that *Rhamphicarpa* occurs in 28 African countries that cultivate rice in rainfed lowland agro-ecosystems, while one or more of the *Striga* species occur in 31 African countries that cultivate rice in rainfed upland agro-ecosystems. An estimated 1.34 million hectares of rice cultivated in rainfed agro-ecosystems are affected by one or other of these parasites. Annual losses of rice are estimated at between US$ 111 million and to US$ 200 million. Moreover, these losses are increasing by US$ 30 million per year (assuming increasing spread over time). The five worst affected countries are, in descending order: Nigeria, Guinea, Mali, Côte d'Ivoire and Cameroon.

Based on these assessments and results, what can AfricaRice offer for parasitic weed management?

A number of rice cultivars developed by AfricaRice are either resistant or tolerant to *Striga*[2] or *Rhamphicarpa*.[3]

Agronomic practices that help include late sowing combined with short-duration cultivars for *Striga*; and early sowing combined with long-duration cultivars for *Rhamphicarpa*.[4]

Rotation and/or intercropping with leguminous crops and zero tillage, combined with direct seeding into crop residues suppresses *Striga* growth.[5] Guidance on these methods is available via a 21-minute video.[6]

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[1] Ouédraogo O, Neumann U, Raynal Roques A, Sallé G, Tuquet C and Dembélé B, 1999. New insights concerning the ecology and the biology of *Rhamphicarpa fistulosa* (Scrophulariaceae). *Weed Research*, 39: 159–169.

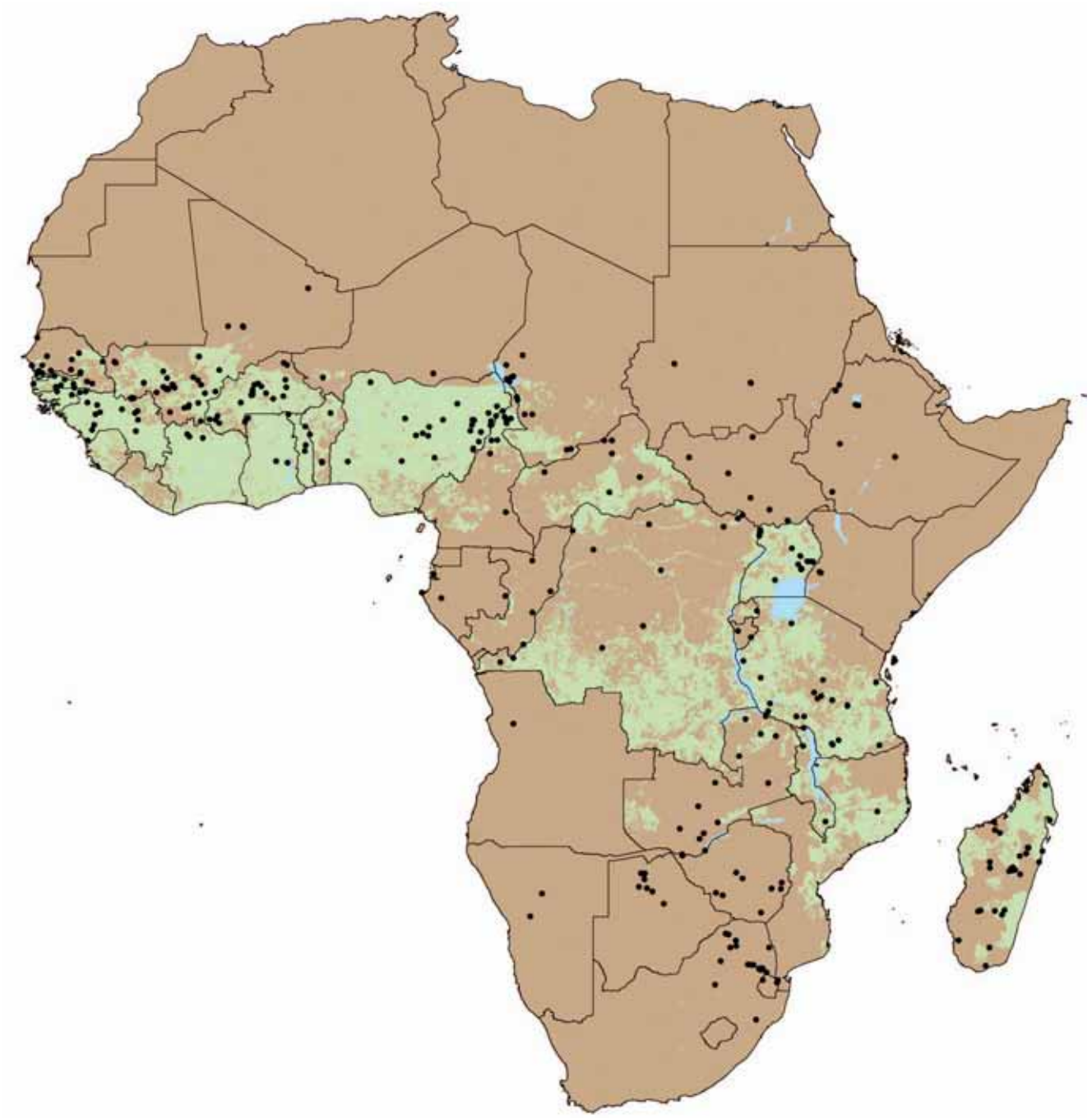
[2] 'Giving farmers the chance to win the fight against witchweed', *AfricaRice Annual Report 2015*, page 12.

[3] Rodenburg J, Cissoko M, Dieng I, Kayeke J and Bastiaans L. 2016. Rice yields under *Rhamphicarpa fistulosa*-infested field conditions, and variety selection criteria for resistance and tolerance. *Field Crops Research*, 194: 21–30.

[4] Tippe DE, Rodenburg J, van Ast A, Anten NPR, Dieng I, Kayeke J, Cissoko M and Bastiaans L. 2017. Effect of sowing time on parasitic weeds in rain-fed rice production systems. *Field Crops Research*, doi: 10.1016/j.fcr.2017.08.013.

[5] Randrianjafizanaka MT, Autfray P, Andrianaivo AP, Ramonta IR and Rodenburg J. 2017. Combined effects of cover crops, mulch, zero-tillage and resistant varieties on *Striga asiatica* (L.) Kuntze in rice–maize rotation systems. *Agriculture Ecosystems and Environment*, in press.

[6] Africa Rice Center, CIRAD and FOFIFA. 2015. *Striga* management. 21 min 26 s. https://www.youtube.com/watch?v=EguvQQDV1Wo. AfricaRice, [Abidjan]; CIRAD, [Paris]; FOFIFA, [Antananarivo].



Distribution of Rhamphicarpa fistulosa *(black dots) overlaid on rainfed rice area (green shading) in Africa (major water bodies are shown in blue)*

Improving salt tolerance of rice in lowland agro-ecosystems in West Africa

Rice can be affected by salt through poor irrigation practices, such as recycling irrigation water, or a shallow saline water table, which affects coastal and estuarine areas. Over a quarter of West Africa's 4.4 Mha of irrigated, rainfed lowland, mangrove-swamp and deep-water rice area is affected by salt stress — either salinity, from the presence of sodium salts, or sodicity, from excess exchangeable sodium, in the soil or irrigation water. Excess salt/sodium affects plants' physiology in general, and in particular respiration, photosynthesis and biological nitrogen fixation, with negative effects on yield. Some 30% of rice farmers consider salt stress a major constraint to production, inflicting yield losses up to 36%.

Research carried out by AfricaRice involved the introgression of the *Saltol* gene, which confers salt tolerance in rice seedlings, into a popular cultivar Rassi,[1] introduced to West Africa from India in the early 1980s, and widely grown in salt-affected areas of The Gambia, Mauritania and Senegal.

Some 16 *Saltol*-introgressed lines (ILs) were identified that had 3–26% yield loss under salt stress compared to unstressed controls. Eight of these *Saltol*-ILs showed high yield potential under both saline and non-saline conditions. The 16 ILs performed consistently across

[1] For more details, *see* 'Breeding for salinity tolerance — the *Saltol* gene', *AfricaRice Annual Report 2013*, pages 29–32.

We integrated modern molecular breeding tools with traditional crossing to speed up the variety-development process — Kofi Bimpong, AfricaRice molecular biologist

Africa-wide Rice Breeding Task Force trials in The Gambia, Guinea, Guinea-Bissau, Nigeria, Senegal and Sierra Leone over three seasons. As a result, Guinea released three of these *Saltol*-ILs (locally named Mamya, Tonsekerin and Toureya) as cultivars for salt-affected lowland rice cropping in 2016, which are now in the cultivar catalog of the Economic Community of West African States (ECOWAS) and therefore officially available for use in all ECOWAS member states.

An estimated 485,000 households in West Africa are potential beneficiaries of salt-tolerant rice cultivars that will enable them to produce normal to good rice yields on salt-affected fields. In Guinea, for example, an estimated 360,000 farming households grow rice in irrigated, lowland, mangrove or deep-water agro-ecosystems which are likely to be saline.

With the release of these three salt-tolerant cultivars, rice farmers on salt-affected land could increase their yields by up to 50% and stabilize yields across good- and bad-salt fields and years.

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Field visit to a mangrove field in Guinea where the newly developed Saltol *lines are grown*

Screening for salt tolerance at vegetative stage: Tolerant lines (right) compared with susceptible lines (left)

Senegal set to release hybrid rice cultivars

Hybrid rice has great potential to boost production and promote seed businesses as it typically yields 15–20% more grain than inbred ('normal') cultivars as a result of hybrid vigor (heterosis). Hybrid rice is already playing an important role in rice self-sufficiency in Africa's only rice self-sufficient economy, Egypt. It is all the more important for Africa to develop its own hybrid rice seed production in order to reduce or eliminate the risk of Asian rice pests and diseases entering the continent with imported seed. It can provide an avenue for African rice farmers to raise their rice yields and profitability.

In 2010, AfricaRice launched its own hybrid rice breeding program to develop locally adapted hybrids. Backcross breeding resulted in the development of new cytoplasmic male sterile (CMS) rice lines with good agronomic and outcrossing characteristics to obtain high seed yield, while test-crossing and microsatellite screening led to the identification of suitable restorer lines, including some lowland NERICA (NERICA-L) and Sahel cultivars, for the three-line CMS system of hybrid production.

The program also aimed at simplifying the rather complex three-line CMS system used by introducing the simpler two-line system, which relies on environmental genetic male sterility (EGMS), which is more economical and yet shows similarly high heterosis. Moreover, in the Sahel region, the day length and high temperatures of the dry season favor EGMS, and rice flowering in the wet season is an important factor for seed multiplication, which maintains the EGMS lines.

"Using data from extensive field experiments at Ndiaye [AfricaRice Sahel station], we developed a model to determine the optimum planting times for seed production and EGMS multiplication," says AfricaRice crop modeler Pepijn van Oort. The research also found that EGMS in the two test lines is caused by a single recessive gene, and is easy to transfer to another genetic background. A simple procedure was used develop a new set of EGMS lines with good agronomic and outcross traits.

"The two-line system reduces costs and is easier for seed companies to implement," says AfricaRice hybrid rice breeder Raafat El-Namaky.

Capacity-building of public and private seed companies is an important component of the hybrid rice program. Newly developed hybrid lines that performed well at the research station are now being tested by seed companies in Burkina Faso, Kenya, Mali, Mauritania, Nigeria, Senegal and Uganda.

Farmers who have participated in selection are showing a keen interest in hybrid rice. Some 50 new highly adapted hybrid lines have shown 15–20% yield advantage (paddy yield 10–13 t/ha), many of which have short life cycles, desirable grain quality and good milling recovery. Four of these lines were grown in large demonstration plots in farmers' fields in Senegal, and two of these have been selected for release in 2017 (*see overleaf*). Similar processes are ongoing in Mali, Nigeria and Uganda.

African farmers typically save their best grains as seed for the next season, despite extension services' efforts to encourage the purchase of quality seed each season. According to economic analyses, the increase in yield farmers can achieve by switching to hybrid cultivars translates into about 40% increased income. Seed companies that adopt hybrid rice are embarking on a very profitable and growing business that will provide jobs for technicians and youth. To make it economically viable, it is necessary to raise the yield of hybrid seed production to at least 2–3 t/ ha. Governments will benefit from increased domestic rice production and its positive impact on the economy through employment and taxes.

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AR032H and AR051H, the two hybrid rice cultivars set for official release in Senegal in 2017, as grown in the 'off-season' in farmers' fields in 2016

Samba Diallo, local rice farmer examining hybrid rice plants at AfricaRice station in Saint Louis, Senegal

AfricaRice believes that hybrid rice technology can help leverage private-sector investment in rice R&D in Africa

Out-scaling Smart-valleys to boost rice productivity

Africa's inland valleys — the future food baskets of the continent — occupy an estimated 190 Mha.[1] The Smart-valleys approach begins by establishing a development plan in collaboration with farmers. This involves the identification of appropriate inland-valley sites for rice production (suitable land, access to markets, site and soil assessments), then the organization of local farmers for clearing the lowland and assessing its characteristics (especially water-flow routes); constructing infrastructure (canals, bunds, land-levelling); producing rice using appropriate technologies; and end-of-season maintenance.

"In general, any inland valley with U shape and with surface area larger than 5 ha can be considered suitable for Smart-valleys," says AfricaRice post-doctoral fellow in agriculture and climate change Elliott Dossou-Yovo. "However, the success of the approach depends more on the participation of farmers and on socioeconomic conditions including land tenure and market opportunities."

The Smart-valleys approach has its origins in the *sawah* system development, tested and refined in Togo from 2004. AfricaRice further refined the approach in Benin under the 'Sawah, market access and rice technologies for inland valleys' (SMART-IV) project (2009–2014). By the end of the SMART-IV project, 139 operational sites had been established, and farmers were duplicating the approach on their own land. Moreover, around 2000 farmers (55% women), 87 technicians and 47 lead farmers had been trained in Smart-valley development.

Participating farmers achieved significant yield increases: from the less than 2 t/ha previously to more than 3.5 t/ha. In addition, their gross revenue had increased from between 136,000 FCFA (US$ 241) and 233,000 FCFA (US$ 413) to between 250,000 FCFA (US$ 443) and 417,000 FCFA (US $740). Farmers testify that they are now less vulnerable to drought, flooding and crop failure, and therefore can afford to invest in inputs (seed, fertilizer) to increase rice productivity.

In light of the improved yields and income observed in Benin and Togo, the Smart-valleys approach is now considered as one of AfricaRice's scalable technologies for promotion throughout the continent, and is being demonstrated at various locations, especially within the rice sector development hubs. Demonstration has continued in Benin and Togo, since early 2016, with the 'Novel approaches for efficient targeting and equitable scaling of rice technologies' (ETES-Rice) project. In this project, the focus has specifically been on women and youth, with 40 technicians trained in the two countries in 2016. The approach is also being scaled out in Liberia and Sierra Leone.

Awareness creation of Smart-valleys among African governments, donors and development partners is being carried out through meetings, technical and policy briefs, and the development of a video. As a consequence, Smart-valleys is now included in Benin's agricultural agenda, led by the country's ministry of agriculture, livestock and fisheries.

Training provided in the Smart-valleys approach by AfricaRice in 2014 for the NGO Women in Law and Development in Africa (WiLDAF) resulted in the development in 2015 of nine sites totaling over 3.9 ha in Togo. Within a period of 9 months, neighboring rice farmers had achieved yield increases of between 100% and a massive 441%, over 1.55 ha. In 2016, GFA Consulting Group GmbH (funded by GIZ) recruited Dominique Hounton, a former technician of the SMART-IV project, to provide support to rice farmers in the development of an inland valley in Materi, northern Benin. Satisfied with the results, GFA Consulting Group plans to train seven field

[1] "Based on FAO and national databases, in particular FAO TERRASTAT (2003)" (Rodenburg J. 2013. Inland valleys: Africa's future food baskets. In Wopereis MCSW, Johnson DE, Ahmadi N, Tollens E and Jalloh A eds. *Realizing Africa's Rice Promise.* CAB International, Wallingford, UK).

technicians and develop more inland valleys using the Smart-valleys approach in 2017.

Ongoing plans aimed at increasing the adaptive capacity of Burkinabe farmers through climate-smart rice technologies, with a particular focus on Smart-valleys, will be implemented through the project 'Climate-smart rice technologies to enhance resilience of smallholder rice farmers in Burkina Faso' (CSA-Burkina), that will begin in 2017. AfricaRice itself plans to scale out Smart-Valleys to other countries, including Côte d'Ivoire and Ghana.

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Top: Construction of Smart-valley main canal, Materi, Benin. Bottom: Growing rice crop, Smart-valley, Materi, Benin

Wide-scale deployment of RiceAdvice in Mali and Nigeria

The RiceAdvice app is a crop management decision-support tool that runs on Android tablets and smartphones. It was developed by AfricaRice to provide field-specific recommendations for efficient mineral fertilizer application. Under the guidance of RiceAdvice service providers, farmers interact with the app to generate recommendations based on target yields and available financial resources.

Dissemination and deployment of the app in Mali and Nigeria in 2016 was realized through a Japanese Government-funded project. AfricaRice partnered with two development institutions (GIZ's Competitive African Rice Initiative [GIZ-CARI] and the Syngenta Foundation for Sustainable Agriculture) as well as national agricultural research and extension systems such as the Institute d'Économie Rurale (IER) of Mali, National Cereals Research Institute (NCRI) of Nigeria and Institute for Agricultural Research, Ahmadu Bello University of Nigeria.

The project trained 331 people in RiceAdvice and other good agricultural practices. Over two-thirds (238) of those trained became professional RiceAdvice service providers, including 14 women and 164 youth (under 40 years old). These new service providers gave RiceAdvice guidance to over 19,000 farmers throughout the rice-growing season. The project raised awareness of RiceAdvice among extension agents, donors and the private sector via a dedicated website,[1] Facebook[2] and a video (available via the website and YouTube).

RiceAdvice recommendations were supplied and used for 8493 ha, and achieved an average yield increase of around 1 t/ha. Overall estimates were 9323 tonnes of additional production worth US$ 3.9 million. Almost all (99%) farmer-users of RiceAdvice services said that they would be willing to re-use it in the next season — and they were willing to pay an average of US$ 5 per advice for this service.

In the irrigated rice hub of Kano, Nigeria, RiceAdvice increased yield by about 0.5 t/ha and income by about US$ 500 per hectare. Farmers taking up RiceAdvice used more urea (nitrogen-only fertilizer) and less compound (nitrogen–phosphate–potassium) fertilizer. Some 80% of the farmers attributed three main advantages to RiceAdvice as follows: increased yield, increased income and reduced use of fertilizer.

RiceAdvice is most useful to public- and private-sector extension and development agents and NGOs. The growing market for RiceAdvice recommendations means there are potential employment opportunities for young service providers; the app will therefore also play a part in alleviating youth unemployment. The uptake of RiceAdvice will also increase demand for other agricultural services such as seed, agro-inputs, processing and marketing.

[1] www.riceadvice.info/en/

[2] www.facebook.com/RiceAdvice/

In Nigeria, training in RiceAdvice is being extended to young service providers, public-sector extension agents and private-sector development agents by the same project partners and the Federal Government (through NCRI).

GIZ-CARI is also focusing on reaching female farmers and developing business models for service delivery. Researchers in national research institutes, university lecturers and postgraduate students have also been trained in the use of RiceAdvice, to expand its scope of utilization. In Mali, Syngenta Foundation is training more service providers to work with farmers willing to pay for the service, and IER is out-scaling and testing the app with farmers in several irrigation schemes.

Constraints have been encountered in scaling up and scaling out RiceAdvice. Work to address them began, for example in Kano, Nigeria, in December 2016. With technical support provided by AfricaRice, development partners are expanding RiceAdvice to Burkina Faso and Ghana (GIZ-CARI) and Senegal (Syngenta Foundation). In addition, field testing is ongoing in Ethiopia, Madagascar and Rwanda through the RiceAdvice East Africa project, funded by GIZ.

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RiceAdvice training, Burkina Faso, and Nigeria (inset)

Improving the quality of parboiled rice

In West Africa, parboiling of rice has traditionally been done using rudimentary methods and equipment, thus generating lower-quality and less marketable products. Nigeria, the most populous country in Africa, imports an estimated US$ 1 billion of rice annually, and this high figure is partly due to the popularity, especially in urban areas, of imported brands of rice produced using more sophisticated parboiling processes.

AfricaRice's GEM (Grain quality enhancer, Energy-efficient and durable Material) improved rice-parboiling system has multiple benefits in its use. It has led to the preproduction of cleaner and higher-quality rice; it is more economical than traditional methods, less time-consuming and safer to operate — particularly for female and younger processors — and requires less fuelwood.

AfricaRice demonstrated the use of the GEM parboiling system within six rice innovation platforms (IPs), consisting of groups of rice value-chain stakeholders working together to promote and improve rice agribusiness. This was realized within the context of the AfDB-funded 'Multinational CGIAR support to agricultural research for development on strategic commodities in Africa' (SARD-SC) project carried out in Benin, Niger, Nigeria and Senegal.

This highlight of achievements focuses on the Lafia IP in Nasarawa State, north-central Nigeria. Rice parboiling has traditionally been dominated by men in Lafia, mainly for health-and-safety reasons: traditional 500 kg parboiling vats are heavy and unwieldy, and inefficient traditional heating methods generated a lot of heat and smoke. With the safer GEM facility, 75% of the project's 1215 trainee processors were women, and 25 women's groups were established to enable them to learn and work together at their new businesses.

The GEM parboiling shed contains:

- soaking vessel (1.4 t/day)
- two steamers (each 100 kg per batch)

Women parboilers operating the improved steamer in the improved stove

- improved stove
- hoist–pulley system for rice containers
- drying surface (1.5 t/day)
- water-recycling system
- borehole for clean groundwater.

A separate building houses a modern mill, which keeps husk separate from bran. There is a packing room, and the whole area is fenced to prevent livestock intrusion.

In experimental auctions carried out in Lafia city, 'GEM rice' attracted a 19% premium over traditionally processed rice. Within 6 months of the establishment of the Lafia IP GEM parboiling center, the group had processed 249.2 tonnes of paddy and sold 186.5 tonnes of parboiled rice to 2892 customers from 11 states in Nigeria. The customers were mainly households buying for personal consumption, but also included 84 traders. The sale price of parboiled rice increased from an average NGN 225/kg[1] (US$ 0.63) to NGN 325/kg (US$ 0.90) — a 44% increase.

Beyond the GEM facility itself, local processors in Lafia have adopted good parboiling practices in their

[1] Nigerian naira per kilogram.

own homes; farmers have gained improved access to quality seed to improve the quality of the rice they supply; farmers and processors have taken on more employees; local artisans have been trained to fabricate GEM components; and quality control has been introduced throughout the value chain.

The Lafia IP received numerous visitors interested in replicating the technology elsewhere, representing (among others) the Green Innovation Centre of Ghana, the International Institute of Tropical Agriculture's youth entrepreneurs group, Ebonyi State Government, the Federal House of Representatives and the Chairman of the House Committee on Agriculture, and ARMACO company from Edo State. The success achieved in Lafia has triggered plans for the installation of 12 GEM facilities in Kaduna, Nigeria under the Agricultural Transformation Agenda Support Program in 2017.

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The pulley–hoist and efficient stove help make the GEM setup safer for operators

What prevents East Africa's women rice farmers from adopting modern technologies?

Walking around rice-farming communities in East and Southern Africa and even in AfricaRice's flagship rice sector development hubs (such as Fogera, Ethiopia; Ambohibary and Ankazomiriotra, Madagascar; Kahama and Kilombero, Tanzania), it is evident, even to the casual observer, that many women farmers still use traditional farming methods rather than adopting modern technologies. What exactly is going on? Why don't we see women taking up the labor-saving technologies promoted by extension services? How deep are the issues that prevent or slow such adoption? Are they related to the technology itself, or its delivery? Would a gender-oriented extension system help improve adoption?

As assessment was carried out to better understand these issues. Gender-disaggregated data were procured from 560 rice farmers (288 households) in 27 villages across five hubs in Ethiopia, Madagascar and Tanzania. Farmers were asked about their perceptions of modern farming technologies and extension.

"The study aimed at generating knowledge on why modern technologies were not adopted by East Africa's women rice farmers," says AfricaRice rice value-chain expert Gaudiose Mujawamariya. Focus was on "How should we approach the community even before we talk about technology? How should we target the 'right' user for each technology on offer?"

Like many other labor-intensive farm activities, weeding puts a lot of strain on the body, especially the back

A whole array of constraints to technology adoption were identified and grouped under five broad categories: institutional; access to and control over agricultural inputs; technology-related; household and socio-cultural; and extension-related. The key constraints identified in this study were:

- Lack of farmers' and women's groups offering mutual support, sharing of information and skills, access to resources, and collective action (Madagascar and Tanzania).
- Lack of decision-making power over land (Ethiopia) and the use of inputs. The majority of women in Africa do not own land because of cultural norms, and so cannot make decisions on its use. Many African cultures also inhibit women's access to agricultural inputs and their ability to decide on their use.
- Lack of capital or credit to purchase technologies affects both men and women farmers, but disproportionately affects women.
- Limited access to markets: many rice-growing communities are far from major regional markets, and roads are often poor. Some farmers see no value in producing extra rice if they cannot transport it to market. Specifically for women, the increased produce often implies loss of control on income as men are in charge of marketing (Tanzania).
- Perception of risk and uncertainty about technologies: many farmers prefer to see the advantages of technology with their own eyes. The value of accessible demonstration plots was particularly noted.

- Availability of technology: some technologies promoted in the hubs were not available for rapid adoption (Madagascar and Tanzania).
- Shortcomings in the extension approach: there are too few extension agents and the staff turnover rate is high. So opportunities for farmers to interact with extension agents and develop a relationship with them are limited. There are very few women extension agents; while Tanzanian women farmers were generally happy to interact with male extension agents, those in Ethiopia and Madagascar were less so. There is a general perception that women communicate better with other women. Also, transfer of information from extension to farmers is viewed as often being insufficient and untimely.

This is a strong knowledge base for research and development practitioners to help them design better-targeted approaches to women farmers. Lesson were learned as regards national agricultural programs — for example, governments and education systems need to find ways of encouraging young women into agricultural extension to help women farmers benefit from what modern technologies can offer.

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Focus group discussion, Ethiopia

Capacity development

Developing the capacity of rice stakeholders in Africa is a vital element in the drive toward rice self-sufficiency. Capacity development has been an integral component of AfricaRice's mandate since its creation over 45 years ago. The year 2016 marked the initiation of major changes in the Center's capacity-development program, with a focus in reaching all the major value-chain actors across the continent.

A Capacity Development Unit was established not only to train value-chain actors and upgrade the knowledge and skills of existing stakeholders, but more importantly to clearly account for the contribution to development of the rice sector. In November 2016, a new full-time head was appointed to lead the unit.

It must, however, be emphasized that much of the work carried out at AfricaRice draws on more than one dedicated unit. Other elements of the Center that are key players include the Knowledge Management Unit, the new Regional Training Center, and staff and partners involved in delivering within-project training and in-country training across the continent.

The AfricaRice Regional Training Center, at Boudiouck, Saint-Louis, Senegal, was formally inaugurated by the Minister of Agriculture and Rural Infrastructure of Senegal in 2016. It offers short technical courses for various rice value-chain actors (including those from the private sector and NGOs), national researchers and extension agents, and can host groups of trainees for extended periods.

Courses envisaged to be delivered there include season-long on-site training for young researchers and extension agents, and vocational training for youth who want to engage in rice business. The facilities are open to use by other organizations of the agricultural sector when not in use by AfricaRice.

A major capacity-development event in 2016 was the inauguration of the Green Innovation Center for Benin, established by the GIZ-funded 'Grüne Innovationszentren in der Agrar- und Ernährungswirtschaft' project (GIAE; 'Green innovation centers for the agriculture and food sector') in Cotonou, AfricaRice Benin Country Office. It is designed to serve the whole agricultural sector in Benin. The Green Innovation Center, working together with the AfricaRice Knowledge Management Unit, trained graduates from Université d'Abomey-Calavi and agricultural technical colleges in Benin to become service providers for various agricultural technologies and services, using the AfricaRice Framework for Innovation in the Food Sector.[1] Some 124 young professionals were recruited by the Green Innovation Center in December 2016 and deployed to 173 villages in Benin to provide innovation-support and business-development services to about 30,000 farmers.

Another new joint venture is the e-learning platform,[2] managed by a staff member seconded from the Natural Resources Institute (NRI), as part of a project funded by GIZ. The platform hosts online courses from the AfricaRice Knowledge Management Unit in conjunction with the Green Innovation Center. Again, the platform targets the wider agricultural sector rather than just rice. By the end of 2016, it offered 16 courses on basic agricultural topics (including 4 on rice) and one business course — currently all in French, but English versions will be available soon.

The courses are aimed at internet-savvy but non-academic audiences, and may be used on any mobile device. They offer chapter-based testing to check learning, and then a final test leading to a certificate if the trainee attains a score of 75% or more. The platform allows progression from basic to specialized courses.

AfricaRice continues to host individual students for studies related to professional training and degrees

[1] 'A novel business model to engage youth to scale up technology adoption', *AfricaRice Annual Report 2015*, page 19.

[2] http://elearning.afris.org

from BSc to PhD. Of the 114 students in 2016, 36 (32%) were women.

Group training courses, held in target countries, are increasingly conducted within the rice sector development hubs. This shift of emphasis has seen a huge increase in the number of direct beneficiaries. Together with the training courses conducted at AfricaRice research stations and at the Regional Training Center, at least 4928 people (50.8% women) were trained in 89 groups in 2016.[3]

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[3] For more details on postgraduate trainees and AfricaRice group training courses, *see* 'Training 2016' (page 31).

Top: The new AfricaRice Regional Training Center, Boudiouck, Saint-Louis, Senegal. Bottom: Dedicated recreation area for trainees' and trainers' use at the new Regional Training Center

Partnerships

Partnerships have always been and will continue to be central to the implementation of the AfricaRice research for development strategy. From its core structure as an Association of African member states to collaborating in the field with farmers involved in research for development activities, it's partnerships all the way.

In March 2016, the Board of Trustees approved AfricaRice's first ever Partnership Strategy, which provides guidance for developing partnerships at all levels. The new strategy outlines the Center's partnership experience, successes and lessons learned. It defines three functional categories of partnerships as research, development, and "other" (the funders of research). All partnerships entered into by AfricaRice are established to deliver the Center's objectives, defined in the Research for Development Strategy 2011–2020.

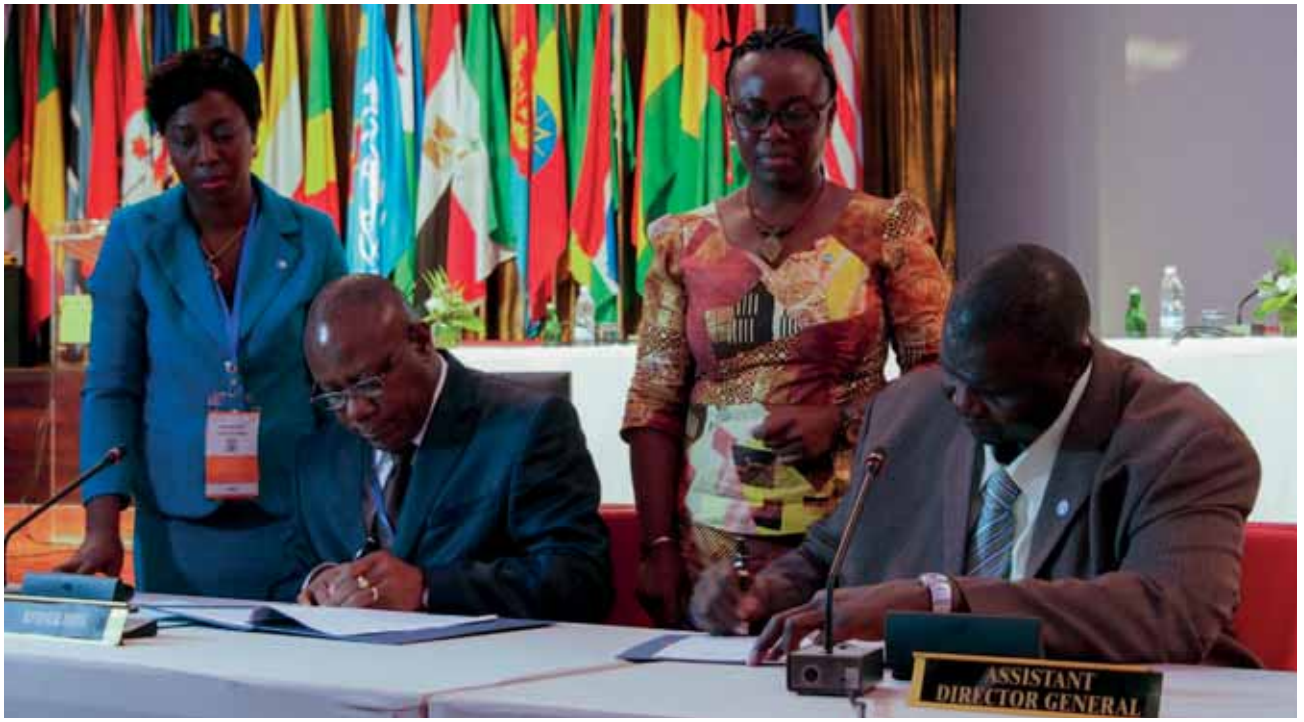
The Partnership Strategy gives guidance on selecting partners, the types of partnership agreements and partnership performance indicators. The latter, which are reviewed as part of the Center's Monitoring, Evaluation and Learning system, are the following: (i) resources jointly mobilized and the number of new donors to the Center; (ii) research and development processes, impacts, outputs and outcomes (e.g. numbers of joint publications, citations, patents, technologies and innovations issuing from partnership activities); (iii) level of achievement of targets, stated goals and objectives of the partnership; (iv) returns on investment; (v) capacitation of partners (number of partners trained and number of backstopping missions); (vi) effectiveness of dissemination and sharing of information; and (vii) sustainability of the partnership.

AfricaRice began implementation of this Partnership Strategy by targeting and consolidating public–private partnerships. This included collaboration with small and medium-sized African enterprises (African SMEs; e.g. Faso Kaba, NAFASO and Hanigha Nigeria Ltd); links with Grow Africa, a joint initiative of the African Union, the New Partnership for Africa's Development (NEPAD) and the World Economic Forum; and consolidation with several private enterprises, especially in the rice seed business. Through partnering with Grow Africa, investments are being leveraged for implementation of the Regional Rice Offensive in West Africa. Partnership with private rice-producing companies and SMEs resulted in the strengthening of national seed systems, the production and delivery of large quantities of certified rice seed for AfricaRice member countries, and adaptation and manufacturing of small-scale farm machinery. Business models encompassing good agricultural practices (GAP) and the Android-based nutrient management tool, RiceAdvice, are being integrated into the activities of the Competitive African Rice Initiative (CARI) project for validation in several AfricaRice member countries resulting in the large-scale dissemination of RiceAdvice.

Memoranda of understanding

AfricaRice signed a memorandum of understanding (MoU) with the **Food and Agriculture Organization of the United Nations** (FAO) during the 29th FAO Regional Conference for Africa in April 2016, in Abidjan. This MoU is for scientific and technical cooperation in implementing the Partnership for Sustainable Rice Systems Development in Africa (PARDA), which will operate in 10 African countries. Under this new MoU, AfricaRice and FAO have already jointly trained Ethiopian national program staff in new survey methods, and strengthened the capacity of rice seed and paddy producers (including community-based seed producers) in six states in Nigeria.

In October 2016, AfricaRice entered into partnership with the **Korean Rural Development Administration**



FAO and AfricaRice sign an MoU for scientific and technical cooperation in consolidating sustainable rice systems development in Africa during the 29th session of the FAO Regional Conference for Africa, Abidjan, Côte d'Ivoire, 8 April 2016

Signing ceremony of an MoU for the Africa Rice Development Partnership, Jeonju, Republic of Korea, 19 October 2016. The signatories were Hwang-keun Chung, Administrator, Rural Development Administration (RDA); Harold Roy-Macauley, Director General, AfricaRice; Joseph DeVries, Chief, Agricultural Transformation Program, AGRA on behalf of AGRA President Agnes Kalibata; Texas A&M AgriLife Research and the Center on Conflict and Development at Texas A&M University (ConDev). Representatives from RDA, the National Institute of Crop Science (NICS) and KAFACI attended the ceremony

(under the umbrella of the **Korea–Africa Food and Agriculture Cooperation Initiative** [KAFACI]), the **Alliance for a Green Revolution in Africa** (AGRA) and **Texas A&M University**. (For more detail on KAFACI and the new partnership, *see* 'Message from the Board Chair and Director General', page 2.). Under this agreement, KAFACI and AfricaRice have organized training of national agricultural research system (NARS) scientists in rice breeding using anther-culture techniques at the AfricaRice Regional Training Center in Saint-Louis, Senegal. In addition to an anther-culture laboratory being set up at AfricaRice Regional Station for the Sahel, Saint-Louis, KAFACI scientists are going to be deployed to the station to work with AfricaRice and NARS breeders on crossing elite Korean and AfricaRice varieties, and their multiplication and dissemination.

Regional involvement

AfricaRice is a member of the **Economic Community of West African States** (ECOWAS) technical working group for the development of the second-generation regional and national agricultural investment plans for food and nutrition (RAIPs and NAIPs). In 2016, the ECOWAS 2025 strategic plan was analyzed, and AfricaRice played a full role in the operationalization of a participatory and inclusive process in the formulation and validation of drafts of the second-generation RAIPs and the Strategic Orientation Framework Horizon 2025. AfricaRice was also asked to lead the convening of rice value-chain stakeholders to prepare a donor conference to solicit investments for the implementation of the ECOWAS Rice Offensive.

CGIAR review of partnerships

CGIAR's Independent Evaluation Arrangement (IEA) evaluated partnerships between CGIAR and non-CGIAR organizations. Early results show that "partnerships are everywhere" – they are an integral part of everything done by CGIAR, with reciprocal influence between research programs and partnerships. However, another finding is that uncertain core funding constrains partnerships, especially with national programs.

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The modus operandi *of AfricaRice is partnership at all levels*

Finance

Statements of activity (expressed in thousands of US$)

	Total 2016	Total 2015
Revenue and gains		
Grant revenue		
Windows 1 and 2	4,249	5,804
Window 3	6,304	2,796
Bilateral	13,275	14,006
Total grant revenue	**23,828**	**22,606**
Other revenue and gains	670	453
Total revenue and gains	**24,498**	**23,059**
Expenses and losses		
Research expenses	20,024	17,877
CGIAR collaboration expenses	581	219
Non-CGIAR collaboration expenses	2,893	2,695
General and administration expenses	2,876	4,186
Other expenses and losses	–	–
Total operating expenses	**26,374**	**24,977**
Financial income	(14)	(23)
Financial expenses	379	572
Surplus (Deficit)	**(2,242)**	**(2,467)**

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 Research Program on Climate Change, Agriculture and Food Security (CGIAR CCAFS)
- Côte d'Ivoire Government
- The Crop Trust
- Department for International Development, UK (DFID)
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- 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)

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* Joined in 2016.
‡ Left in 2016.

Training 2016

AfricaRice training program (courses)

89 Training courses run in 2016

47 Locations in **15** countries

4928 Total trainees

Postgraduate trainees

37 Total female postgrads

78 Total male postgrads

From **24** countries

59 PhD students

... of whom

20 Female

39 Male

25 MSc students

... of whom

8 Female

17 Male

With **41** universities

In **19** countries

17 Funding sources

Publications 2016

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Abbreviations

AfDB	African Development Bank
AfricaRice	Africa Rice Center
AGRA	Alliance for a Green Revolution in Africa
ARICA	Advanced Rice for Africa (varieties)
AUC	African Union Commission
BMZ	Federal Ministry for Economic Cooperation and Development (Germany)
BoT	Board of Trustees
CARD	Coalition for African Rice Development
CARI	Competitive African Rice Initiative (GIZ)
CIMMYT	International Maize and Wheat Improvement Center
CIPRiSSA	Continental Investment Plan for Accelerating Rice Self-Sufficiency in Africa
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (France)
CMS	cytoplasmic male sterile
CoM	Council of Ministers (AfricaRice)
ConDev	Center on Conflict and Development (Texas A&M University)
COP	Conference of the Parties to the United Nations Framework Convention on Climate Change
CRP	CGIAR Research Program
doi	Digital Object Identifier
ECOWAS	Economic Community of West African States
eds	editors
EGMS	environmental genetic male sterility
ETES-Rice	Novel Approaches for Efficient Targeting and Equitable Scaling of Rice Technologies (project)
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FCFA	CFA franc
FOFIFA	Centre national de recherche appliquée au développement rural (Madagascar)
GAP	good agricultural practice(s)
GEM	Grain quality enhancer, Energy-efficient and durable Material
GIAE	Grüne Innovationszentren in der Agrar- und Ernährungswirtschaft project (Green Innovation Centers for the Agriculture and Food Sector)
GIC	Green Innovation Center (BMZ)
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRiSP	Global Rice Science Partnership
IEA	Independent Evaluation Arrangement (CGIAR)
IER	Institute d'économie rurale (Mali)
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
IL	introgressed line
IP	innovation platform

IRRI	International Rice Research Institute
IsDB	Islamic Development Bank
ISRFG	International Symposium on Rice Functional Genomics
KAFACI	Korea–Africa Food and Agriculture Cooperation Initiative
MoU	memorandum of understanding
NAIP	national agricultural investment plan for food and nutrition
NARS	national agricultural research system(s)
NCRI	National Cereals Research Institute (Nigeria)
NEPAD	New Partnership for Africa's Development
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
NRI	Natural Resources Institute (University of Greenwich, UK)
OCP	Office Chérifien de Phosphates
PARDA	Partnership for Sustainable Rice Systems Development in Africa
pp.	pages
RAIP	regional agricultural investment plan for food and nutrition
RDA	Korean Rural Development Administration
RICE	Rice Agri-food Systems (CRP)
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 (project)
SME	small and medium-sized enterprise
TICAD	Tokyo International Conference on African Development
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
WiLDAF	Women in Law and Development in Africa

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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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