Annual Report

2023

AfricaRice

CGIAR

Content

Who we are **4**
Vision 4
Mission 4
Message from the Director General **5**
Message from the Board Chair **6**
List of acronyms **7**
Research for Development operations of AfricaRice under One CGIAR **8**
Working as part of One CGIAR: innovations and knowledge toward impacts 8
Linkage with the engagement approach of One CGIAR 9
Policy, Innovation System, and Impact Assessment (PII) program **10**
Story: Improving women's livelihoods and nutrition in sub-Saharan Africa through improved parboiling equipment and method 12
Sustainable Productivity Enhancement (SPE) program **13**
Genetic Diversity and Improvement (GDI) program **16**
Story: A global rice breeding solution to address global challenges 19
Rice Sector Development (RSD) program **20**
Story: Auto CO2-generating hermetic storage cocoons to protect rice after harvest 22
History of the AfricaRice Breeding Task Force **24**
Story: Enhancing rice breeding efficiency through the genomic selection approach 26
The Rice Biodiversity Center for Africa **28**
Rice Seed Service Unit **30**
Story: Sustaining and enhancing rice yields in the face of climate change 31
Gender equality and social inclusion **32**
Story 1: Barriers to the adoption of climate-smart technologies in rice cultivation by women: a perspective from Mali 32
Story 2: Persistence of gender inequalities in access to land in the rice sector: a perspective from Ghana 33
Stories **34**
Profitability of rice depends on nitrogen rate, nitrogen source, and the growing season in southwestern Madagascar 34
Transforming Liberia's agriculture: Government and European Union applaud success of integrated rice and fish farming 35
Youth in agribusiness and rice seed production in Nigeria 36
Empowering vulnerable women and young agripreneurs in Senegal with social recognition and power 37
AfricaRice with Korean experience: a winning cooperation 38
Rice symposia, policy dialogues, and seed road map workshops catalyze investment in rice 40
Partnership **42**
Finance overview **43**
Other indicators of financial health 43
Human resource overview **44**

Who we are

The Africa Rice Center (AfricaRice) is a leading pan-African center of excellence for rice research, development and capacity building. Its work contributes to reducing poverty, ensuring food and nutritional security, and improving the livelihoods of farmers and other actors in the rice value chain in Africa. It does this by increasing the productivity and profitability of rice-based agri-food systems, while ensuring the sustainability of natural resources.

AfricaRice highest governing body is the Council of Ministers. This unique governance gives AfricaRice unparalleled access to the highest levels of decision-making in African governments. AfricaRice has been given the mandate to support the continent in developing the rice sector through research, development, and partnership activities. AfricaRice is a CGIAR Research Center — part of a global research partnership for a food-secure future.

VISION

To sustainably improve food and nutrition security for a healthy and prosperous Africa.

MISSION

To deliver rice-based innovations and transformed rice-based agri-food systems that contribute to the transformation of food, land and water systems in the face of climate change.

Message from Director General

Dear partners, colleagues, and friends,

This marks my first foreword for an AfricaRice Annual Report, as I was appointed Director General in April 2023. It has been a great and exciting first year, full of challenges but mainly full of joy and celebrations. It is therefore my pleasure to share the AfricaRice 2023 Annual Report with you. The report showcases a summary of the concerted efforts of our staff, partners, stakeholders, and donors during the year under review.

During the year, AfricaRice had the privilege to be awarded the prestigious Milken-Motsepe Prize for rice varieties, jointly with a team from the International Rice Research Institute, as a recognition for our combined project where we developed new flood-tolerant rice varieties using modern breeding technologies with the SUB1 gene.

Throughout the year, the intensive program of interactions conducted with member countries generated key outcomes such as an increased annual contribution by member, the introduction of a National Rice Forum for each member country, and an enhanced collaboration with the AfricaRice headquarters host country of Côte d'Ivoire. We also intensified our consultations with regional bodies and international organizations, including the Economic Community of West African States (ECOWAS), West African Economic and Monetary Union (UEMOA), International Fund for Agricultural Development (IFAD), French Agricultural Research Centre for International Development (CIRAD), French National Research Institute for Sustainable Development (IRD), African Development Bank (AfDB), Islamic Development Bank (IsDB), Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI), Korea International Cooperation Agency (KOICA), Korea Program on International Agriculture (KOPIA), German Development Cooperation (GIZ), United Nations Environment Programme (UNEP), Bill & Melinda Gates Foundation (BMGF), European Union (EU), and World Food Programme (WFP).

As a member of CGIAR, AfricaRice's research activities are continually aligned with the One CGIAR Research Initiatives, and we are involved in the implementation of 9 out of the 33 initiatives.

In Madagascar, the Genetic Diversity and Improvement program released the blast- and salt-tolerant variety FOFIFA 197 for irrigated lowlands as well as the submergence-tolerant FOFIFA 198, while in Uganda, we released the aromatic Tongil variety UKAFACI 39. Under our Sustainable Productivity Enhancement program, we worked to diversify rice-based systems while improving farmers' incomes and nutrition with highly profitable systems, such as rice–vegetable/bean and rice–tomato/onion in Senegal; rice–cucumber and rice–tomato in Côte d'Ivoire; rice–lettuce and rice–Chinese white cabbage in Madagascar; and rice–fish in Liberia, Côte d'Ivoire, and Mali. The Rice Sector Development program enabled us to strengthen partnerships with public and private sector rice value-chain actors in the dissemination of proven technologies. The Seed Unit at AfricaRice, in its seed scaling activity, disseminated more than 8,700 kilograms of mainly breeder seeds, including hybrids, to 22 seed enterprises in nine countries. This increased the production and delivery of different categories of quality seeds in partnership with the private sector.

Our gratitude goes to the CGIAR System Board, the AfricaRice Board, our donors, our institutional stakeholders, our private partners, our individual supporters, as well as our dedicated staff who work to transform the lives of value-chain actors and their communities.

I wish you pleasant reading and thank you for your trust in AfricaRice.

Dr Baboucarr Manneh
Director General AfricaRice

Message from the Board Chair

Warm greetings from the Board of Trustees of AfricaRice. For us, this is a time of reflection on the activities and achievements of the past year.

In spite of the effects of the many conflicts and worsening climate crisis in the region and in the international community, as these continue to impact on the center's activities, AfricaRice remains focused on its goal: to effectively support, and contribute to ensure that Africa attains, rice self-sufficiency by 2030, as enshrined in its refreshed strategic plan.

AfricaRice's 2030 rice research and innovation strategy for Africa further provides a strategic road map for enhancing the optimal functioning of the center amid the hurdles and challenges of today.

It has been a successful year for the Board of Trustees, and we congratulate Dr. Baboucarr Manneh for his appointment as the fifth Director General of AfricaRice. During the year, we held the 54th Board of Trustees meeting virtually, and the 55th meeting in person on the premises of the AfricaRice M'bé Research Station in Côte d'Ivoire. These two meetings were opportunities to make several decisions that will positively contribute to creating an enabling environment for our operations and a conducive environment that promotes staff well-being.

We are proud that AfricaRice has been the recipient of two prestigious international recognitions this year:

- A 2023 Presidential Citation of the Republic of Korea for sustainable partnership to Dr. Baboucarr Manneh, Director General of AfricaRice.
- A recognition from Elsevier to Aminou Arouna, leader of the Policy, Innovation Systems, and Impact Assessment program, for the contribution of five articles that were linked to the United Nations Sustainable Development Goals, helping to tackle some of the world's greatest challenges.

AfricaRice continues to position itself as the partner of choice for rice research and value-chain improvement in Africa. In 2023, the center was engaged in strategic partnership through its active participation in about 30 congresses, conferences, workshops, and symposia worldwide.

AfricaRice has also prioritized interactions within CGIAR, focusing on aligning the center's operations with One CGIAR, and we remain confident that this will have a positive impact on the joint implementation of CGIAR Research Initiatives, the project pipeline, corporate affairs, and governance matters.

We thank the staff for their dedication, and we extend our heartful gratitude to our partners and donors that have placed their trust in AfricaRice.

I hope you will enjoy discovering the exciting achievements of AfricaRice in 2023 that are presented in this report.

Kanayo F. Nwanze
Chair of the Board of Trustees

List of acronyms

AfDB	African Development Bank
BMGF	Bill & Melinda Gates Foundation
CIAT	International Center for Tropical Agriculture
CORAF	West and Central African Council for Agricultural Research and Development
CSA	Climate smart agriculture
DeSIRA	Development Smart Innovation through Research in Agriculture
GDI	Genetic Diversity and Improvement
GEM	Grain quality enhancer, Energy-efficient, and durable Material
GRBP	Global Rice Breeding Program
IFAD	International Fund for Agricultural Development
IRRI	International Rice Research Institute
KAFACI	Korea-Africa Food and Agriculture Cooperation Initiative
NARS	National agricultural research systems
NPK	Nitrogen, phosphorus, and potassium
PII	Policy, Innovation Systems, and Impact
QTL	Quantitative trait locus
RBCA	Rice Biodiversity Center for Africa
ROCARIZ	Rice Research and Development in West and Central Africa
RSD	Rice Sector Development
SPE	Sustainable Productivity Enhancement
TAAT II	Technology for Africa Agricultural Transformation phase II
WARDA	West African Rice Development Association

Research for Development operations of AfricaRice under One CGIAR

AfricaRice has its headquarters in Abidjan, Côte d'Ivoire and main research station in M'bé, near Bouaké, Côte d'Ivoire. The center has substations in Antananarivo, Madagascar; Ibadan, Nigeria; Kampala, Uganda; and St. Louis, Senegal.

AfricaRice has four Research for Development (R4D) programs. The Genetic Diversity and Improvement (GDI) program covers genetic conservation, pre-breeding, and breeding. The Sustainable Productivity Enhancement (SPE) program covers agronomy and post-harvest research. The Policy, Innovation Systems, and Impact Assessment (PII) program covers policy support, rice value-chain analysis, production economics, and impact assessment. Finally, the Rice Sector Development (RSD) program handles scaling of innovations—with the emphasis on seed for farmers to have an access to quality seeds of high-performance varieties—and the coordination of development projects.

All AfricaRice scientists belong to one of these four programs, and one scientist in each of the substations serves as a country and regional representative. The programs are detailed in the articles on the following pages of this report. Since almost all projects and CGIAR Research Initiatives are multidisciplinary in nature, however, scientists work together beyond the programs. Program scientists also plan and implement capacity strengthening of various stakeholders with secretarial support from the AfricaRice administration.

WORKING AS PART OF ONE CGIAR: INNOVATIONS AND KNOWLEDGE TOWARD IMPACTS

The R4D contents of GDI, SPE, and PII correspond exactly to the One CGIAR action areas of Genetic Innovation, Resilient Agri-food Systems, and System Transformation. RSD plays a cross-cutting role to accelerate scaling of the innovations that GDI, SPE, and their partners have developed and polished to readiness for scaling conditions. The scientists working within GDI, SPE, and PII are in the lines of the corresponding One CGIAR action areas, while the scientists who belong to RSD are in the lines of the action areas most relevant to their disciplines.

GDI and SPE can achieve impacts in all five CGIAR impact areas—Nutrition, Health, and Food Security; Poverty Reduction, Livelihoods, and Jobs; Gender, Equality, Youth, and Social Inclusion; Climate Adaptation and Mitigation; and Environmental Health and Biodiversity—through innovations created by their R4D actions.

Business models where some innovations are disseminated create jobs for women and youth—for example, jobs for women in the GEM parboiling system and for youth as service providers in RiceAdvice—and contribute to some of the five impact areas. Information collected and knowledge aggregated by PII are indispensable to innovation development by GDI and SPE and can facilitate environments enabling significant innovation adoption and scaling. RSD can accelerate scaling of innovations by GDI and SPE and the achievement of impacts.

LINKAGE WITH THE ENGAGEMENT APPROACH OF ONE CGIAR

Each country and regional representative also serves as a country convenor of their country of residence, playing a crucial role in the country engagement of One CGIAR. In addition, a program leader of RSD who works at the M'bé Research Station acts as a country convenor for Côte d'Ivoire. The convenors facilitate country-level engagement by all partners in Côte d'Ivoire, Madagascar, Nigeria, Senegal, and Uganda. All of these are AfricaRice member countries—the center has 28 member countries in Africa—and AfricaRice stays in a favorable position facilitating in-country activities in those countries.

The Directors General of the national agricultural research systems (NARS) in each of the member countries form a National Experts Committee supporting AfricaRice, giving the center a strong link and entry point to country-level engagement, i.e. NARS, that extends beyond just rice. Thus, AfricaRice has a comparative advantage in facilitating country-level engagement.

The center has been operating in the whole of sub-Saharan Africa with various types of collaborators and partners, including other CGIAR centers. The center plays a crucial role for regional engagement in Africa, beyond West and Central Africa, where the AfricaRice Director General has responsibility as a regional director.

Policy, Innovation System, and Impact Assessment (PII) program

The PII program aims to enhance income and food and nutrition security and improve the livelihoods and resilience of rural and urban populations in Africa through evidence-based knowledge and information to generate demand-driven rice technologies, policies, and institutions, and to increase the effectiveness of processes of development and dissemination of sustainable technologies and institutions.

To achieve this objective, the PII program is operating around six research units related to policy, production, value chains and markets, gender, innovation systems, and impact assessment. The PII program works closely with national research systems in 30 countries (the 28 AfricaRice member countries plus Tanzania and Burundi) through two task forces: a Gender Task Force and Policy and Economics Task Force. Activities are conducted in partnership with all value-chain actors, private actors, advanced research institutes, and universities.

In 2023, the program collaborated with numerous different partners, from advanced research institutes and universities including Arizona University (USA), Bordeau University (France), Maryland University (USA), Pennsylvania State University (USA), Saskatchewan University (Canada), Sidney University (Australia), Thünen Institute (Germany), and Wageningen University (Netherlands); to private enterprises such as ATAFI Agro Merchandise Service and Green Sahel; to non-governmental organizations like Manobi Africa and Syngenta Foundation. The PII program has contributed to five CGIAR Research Initiatives (Excellence in Agronomy, HER+, Market Intelligence, Plant Health, and West and Central African Food Systems Transformation) and five projects (Accelerating Impacts of CGIAR Climate Research for Africa, Development Smart Innovation through Research in Agriculture, HealthyDiets4Africa, the Project for Value Chain Development in Senegal, and the Rice Agripreneurship Project).

As results of these partnerships and projects, three Women and Youth Innovation Platforms were introduced and installed in Ghana and Senegal. These Innovation Platforms will allow women and youth to engage with other value-chain actors to increase employment and income. The PII program conducted several activities on capacity building, including the training of 100 youth enterprises in rice value-chain activities, 190 persons (122 men and 68 women) in automated data collection using android applications, and 55 Young Service Providers on RiceAdvice and WeedManager.

In terms of policy research, the PII program contributed to two book chapters—one on farmers' risk preferences and willingness to pay for African rice landrace seed, and one on ways AfricaRice is helping achieve the Sustainable Development Goals. The latter chapter found that AfricaRice has contributed to nine of the Sustainable Development Goals, namely Goals 1, 2, 3, 4, 5, 6, 8, 9, 12, 13, 15, and 17.

On 21 July 2023, the Government of India announced a ban on the export of non-basmati rice. India is exporting 30–40% of rice to the world and the majority in Africa. To avoid negative impacts of this policy on African countries, AfricaRice developed and published a policy brief that included measures for the short, medium, and long term.

The program also conducted surveys which have led to contributions to 11 peer-reviewed journal articles. Among these publications, a survey was conducted to understand consumer preferences

for rice quality attributes in Uganda and Kenya to inform the countries' rice breeding programs and value-chain development interventions. The survey found that Ugandan consumers are willing to pay a price premium for rice with a relatively high proportion of intact grains, but the consumers discount chalkiness; meanwhile, Kenyan consumers discount high amylose content and impurities.

Another survey assessed farmers' willingness to pay for digital advisory services. Here, 49% of farmers selected cash payment after harvest at US$ 9.70 per hectare for a more than two seasons contract as the first option. This is the first evidence of the feasibility of an indirect approach through such a business model for long-term scaling and adoption of digital extension technologies by smallholder farmers in sub-Saharan Africa.

Improving women's livelihoods and nutrition in sub-Saharan Africa through improved parboiling equipment and methods

Hidden hunger is increasing in sub-Saharan Africa. The region has the highest prevalence of undernutrition, with sparse progress in recent times. One in two Africans face hidden hunger, and it stalks 98 million children in sub-Saharan Africa.

To improve the nutritional quality of rice as a staple food crop, AfricaRice and partners have developed an improved parboiling system called "Grain quality enhancer, Energy-efficient, and durable Material" (GEM for short), which allows the processing of high-quality rice with better physical and nutritional properties compared to traditional systems. The GEM parboiling technology combines the use of a uniform steam parboiler and an improved parboiling stove. The GEM system is not only about the equipment, however, but a complete improved process.

As of January 2022, the GEM system had been scaled to 11 African countries. Through the ESAParboil project, the PII program introduced the GEM parboiler and improved parboiling method in East Africa. Rice parboiling technology and the advantages of parboiled rice are increasingly recognized in this part of the continent. In Madagascar, domestically parboiled white, pink, and red rice is now available in local markets—and not only in production zones but also in supermarkets. Through policy engagement, improved rice parboiling technology was included in the country's national rice development strategy for improving the nutritional quality of locally produced rice.

Women's groups are leading the dissemination and making forward linkages with other actors, such as seed production and distribution actors in Vakinankaratra, Madagascar. To increase the scaling of the GEM parboiler in East Africa, 14 fabricants and artisans were trained on manufacturing the parboiler, while 900 women were trained on use of the parboiler and the improved GEM method. Women's associations benefited in setting up eight parboiling units. About 5,700 individuals gained awareness of parboiled rice and its nutritional benefits in Madagascar and Mozambique.

In West Africa, where GEM was introduced starting in 2015, a survey conducted by AfricaRice assessed the impact of the adoption of the GEM system on women's livelihoods. Results showed that adoption of the GEM system increased women parboilers' rice output rate, income, and food security and reduced poverty. Compared to a traditional system, the GEM parboiling system allowed the women to gain an additional 140 kilograms of milled rice per ton of paddy, equivalent to US$ 73 of supplementary income. A significantly lower poverty rate of 26% was found among households who adopted the GEM system.

These results are supported by women's perceptions that the output rate, better nutritional value, and reduction of broken rice during dehulling are major advantages of the improved parboiling system. Parboiled rice using improved equipment and methods is not only contributing to reducing hidden hunger in sub-Saharan Africa, but also contributing to the livelihoods of women.

Sustainable Productivity Enhancement (SPE) program

SPE program scientists conduct agronomy and post-harvest studies. The program covers processes from seed up to the market, and upgrades the whole rice value chain to achieve AfricaRice's mission. SPE's efforts seek to achieve rice self-sufficiency in Africa, which will critically contribute to the food security of the continent. To do this, SPE engages in three types of activities: situation and scenario analyses, development of innovations, and assistance to the scaling of innovations.

Information collected through situation and scenario analyses is crucial to develop demand-driven innovations, decide research directions, and generate further evidence-based R4D strategies. Some examples are scenarios to achieve rice self-sufficiency; simulations of yield change under climate change; yield gap and research and development prioritization; analyses of the status quo and challenges of rice production; analyses of rice post-harvest loss; and consumer preference sample analyses and surveys. Surveys on the ground are mostly conducted with NARS partners, and we have started to use machine learning and artificial intelligence to accelerate the efficiency of these.

In 2023, for the first time, farmers' perceptions of water scarcity, key adaptation strategies, and their adoption in irrigated rice schemes were examined in the dry climatic zones of West Africa. Nearly 80% of the respondents reported water scarcity during the preceding five years. Farmers facing drier climatic conditions, those belonging to farming associations, and those in male-headed households tended to adopt and implement more adaptation strategies at once. Another study this year identified climate smart agriculture (CSA) practices in rice farming systems and determined the factors that drive their adoption in Mali. Crop diversification, improved rice varieties, crop rotation, tree planting, micro-doses of organic manure, and micro-doses of mineral

fertilizer were the most-adopted CSA practices here. Key barriers to successful CSA adoption included limited input availability, including of labor and seedlings, and limited land access by women and youth.

Development of innovations during 2023 included many innovations co-designed and developed with international and national partners. Through agronomic approaches, we seek to intensify and diversify rice-based systems, expecting that when yields and profitability increase and production costs fall, local rice can compete with imported rice. In view of productivity, sustainability, and market values, we therefore prioritize flooded lowland rice production for its potential in achieving self-sufficiency. Here, the improvement of water management is a critical productivity enhancement—directly increasing yield and improving the effectiveness of other inputs like fertilizer. The Smart-Valleys approach is one example, and this approach can also sustainably expand lowland rice area, which will be indispensable to achieving rice self-sufficiency. Under climate change, water-saving technologies should also be incorporated widely into water management. Packages of good agricultural practices and agricultural machines such as weeders and seeders are among our other innovations for intensification. In 2023, a good agricultural practices manual for lowland rice in local language was developed and disseminated to 3,500 farmers in Madagascar.

The development of tools also extends to information technology (such as farmers' decision support tools) and artificial intelligence (such as Rice SCOUTER). One new tool is RiceAdvice, a free Android-based application that gives farmers advice on how to improve yields and profitability. The tool has been disseminated in several African countries. RiceAdvice requires situation-specific information to generate its advice, and manipulating it can be complicated for farmers. Thus, a service-provider approach has been mostly adopted for scaling. We further developed RiceAdvice-Lite, which requires less information: this can be provided in just 3 minutes instead of the 23 minutes needed for the original version. RiceAdvice-Lite was validated and piloted in Nigeria and other countries and has been widely accepted by farmers.

For diversification, which doubles as a strongly effective approach to improve nutrient status, we focus on rice–fish systems in partnership with WorldFish and rice–vegetable/bean systems

with the World Vegetable Center. With our post-harvest approaches, meanwhile, we try to reduce post-harvest losses and add value to local rice to enhance its competitiveness. The GEM parboiling system is one promising example. In research this year, we analyzed parboiled and non-parboiled rice for 39 macro- and micronutrients and found that 30 of these were enhanced by parboiling. Among micronutrients likely to be short in Africa, iron content was improved but zinc was not, suggesting that additional measures to improve zinc such as fortification and biofortification will remain necessary.

Finally, SPE's third type of activity is giving assistance to the scaling of innovations. Here, innovations developed or introduced from another region, such as Asia, are validated in local contexts and piloted in some locations. As a starting point for scaling, the innovations are demonstrated. Validation, piloting, and demonstration are most often conducted with NARS partners. We connect ourselves to development partners including those in the private sector, and we support these partners through technical backstopping and capacity strengthening of key stakeholders.

In 2023, we tested ratooning systems using perennial rice varieties developed by Yunnan University, China in Senegal and Côte d'Ivoire. Some ratoon systems showed the same total yield as usual cropping twice a year, but required much fewer inputs, especially for labor, and returned higher profitability. In another pilot this year, we tested Ajinomoto byproduct—containing 15% nitrogen, 5% potassium, and amino acids—as a cheap alternative fertilizer. Demonstration trials have been completed in farmers' fields in three locations of Côte d'Ivoire. A treatment where urea was replaced by Ajinomoto byproduct at the nitrogen equivalent amount in the governmental recommendation (NPK + urea) produced 20–30% higher yield than the governmental recommendation.

Over the course of the year, SPE program scientists published an average of 2.33 journal papers each. Near the end of 2023, from 15–17 November, the agronomists gathered along with research assistants and consultants for an internal agronomy retreat. Based on the recent results, they identified key gaps for future research and discussed the many paths forward for our solutions.

Genetic Diversity and Improvement (GDI) program

The GDI program, through the adoption of the One-Rice strategy, has modernized its facilities and redefined its market segments and breeding into eight pipelines. This has allowed us to reduce the breeding cycle to three years and introduce molecular selection and digitalized data capture to enhance genetic gain. Varietal development is supported by the Grain Quality Laboratory, which investigates key factors such as milling recovery, head rice yield, grain shape, varietal purity, chalkiness, and amylose, protein, iron, and zinc contents. The Plant Pathology Unit screens the varieties for major rice diseases, including Rice Yellow Mottle Virus, blast, and bacterial diseases. The Molecular Biology Laboratory undertakes F1 hybridity testing and quantitative trait locus (QTL) profiling of breeding lines and genotyping of parental lines.

We undertook an in-depth assessment of gender-preferred traits using the Gender+ tool to develop rice product profiles for market segments identified with key stakeholders of the rice value chain in Côte d'Ivoire. The assessment was performed in a participatory and inclusive way, with the preferences of women and men along the rice value chain disaggregated. The results of this study will allow for a better consideration of characteristic preferences to facilitate the adoption of newly released varieties.

Four new upland candidate lines—ART35-252-1-2-B-1, ART27-190-6-1-4-2-2-1, ART35-272-1-2-B-1, and ART34-113-3-2-B-1—have higher yields, early maturity, drought tolerance, and blast resistance. Two aromatic lines are also in the varietal release pipeline—ART35-252-1-2-B-1 and ART34-113-3-2-B-1. The candidates were chosen through on-farm trials and are currently undergoing evaluation for release in Sierra Leone and Guinea through a national performance trial and distinctness, uniformity, and stability testing.

Overall in 2023, 18 climate-resilient, high-yielding, and nutritious rice varieties were released in seven sub-Saharan African countries (see Table 1). This has been accomplished in a collaborative effort with other CGIAR centers, and mainly in partnership with the Korean government through the Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI) (page 38).

Table 1. Newly released varieties in 2023, their yield potential, and important traits

Releasing country	Variety designation	Ecology	Yield potential (tons/hectare)	Important trait
Madagascar	FOFIFA 198	Lowland/irrigated	7	Submergence tolerance
Nigeria	FARO 68	Lowland	11.6	High yield
Mali	BF19AR006	Irrigated	6–6.5	High zinc
	IR107015-69-1-1-B	Irrigated	6.5–7	Aroma
	IR93654-10-2-3-1-ARS-SAL3	Irrigated	6.5–7	Salt tolerance
	NIO-21-2-1	Irrigated	6.5–7	High yield potential
	NIO-21-2-3	Irrigated	6–6.5	High yield potential
Ghana*	CRI-Tuo Mo	Lowland/irrigated	6.9	Blast tolerance
	CRI-Kang Mo	Lowland/irrigated	6.3	Blast tolerance
	CRI-Korea Mo	Lowland/irrigated	7	Blast tolerance
	CRI-Baakoye	Lowland/irrigated	6	Blast tolerance
	CRI-Agyapa	Lowland/irrigated	6.2	Blast tolerance
Senegal*	ISRIZ 16	Lowland/irrigated	9	Drought tolerance
	ISRIZ 17	Lowland/irrigated	9	Blast tolerance
	ISRIZ P01	Upland	2.5	Blast tolerance
	ISRIZ P02	Upland	3	Blast tolerance
Uganda*	Ukafaci 39	Lowland/irrigated	7.2	Aroma
Zambia*	Sahel 134	Lowland/irrigated	7.1	Brown spot resistance

Developing partners' capacity and infrastructure has been a constant commitment of the GDI program. In 2023, NARS from over 20 countries visited the advanced centralized breeding facilities at M'bé Research Station and participated in diverse scientific exchanges. A significant capacity-building initiative launched to share modern breeding program protocols with NARS partners, which involved degree training for five individuals and 49 non-degree training programs. GDI also supplied rice leaf sampling kits, provided training on tissue sampling, and genotyped more than 2,000 genotypes at low-density (F1 hybridity testing and QTL profiling) and mid-density (forward breeding and gene finding) for 21 NARS partners.

The Breeding Program completed its third assessment using the Breeding Program Assessment Tool at M'bé Research Station in late 2023. The commendable achievement of swiftly modernizing the breeding program was highly acknowledged, as was the notable progress made in defining market segments, developing products as per market needs, establishing a short and cost-effective breeding cycle, mechanizing breeding operations, digitalizing data capture and storage, and building a strong Breeding Task Force network with NARS partners in Africa. AfricaRice received recommendations to carefully consider the future direction of the hybrid rice program, explore the use of drones for high-throughput phenotyping, ensure the quality of on-farm trial data, and focus on gene pool composition and maintenance per pipeline. The evaluation concluded positively, with a written report set to follow.

From 4 to 8 December, AfricaRice held Science Week 2023, dubbed "Mobilizing the AfricaRice Research Task Forces to Contribute to the One CGIAR Research Agenda in Africa". This gathering at M'bé Research Station received huge attendance from representatives of the AfricaRice Board of Trustees and National Experts Committee, past AfricaRice Directors General, the CGIAR, regional centers such as the West and Central African Council for Agricultural Research and Development (CORAF) and Forum for Agricultural Research in Africa (FARA), and other international and national partners. Special dedication was given to the Agronomy, Breeding, Gender, Policy, and Post-Harvest Task Forces to share updates, set objectives and discuss workplans for 2024. During Science Week, a Bill & Melinda Gates Foundation (BMGF)-funded project, Multiple-Harvest Rice for Africa, was launched with NARS. This project will focus on identifying suitable varieties for ratooning and developing agronomic packages to reduce the drudgery, labor constraints, and cost associated with seasonal land preparation and seeding/transplanting.

A global rice breeding solution to address global challenges

Rice stands as a primary global crop, cultivated across continents and playing a pivotal role in food security. Nevertheless, the compounding factors of climate change and a relentless surge in demand, surpassing production capacities, demand a unified effort to devise solutions. This need has been acknowledged with the launch of the Global Rice Breeding Program (GRBP), spearheaded by three CGIAR centers: AfricaRice, the International Center for Tropical Agriculture (CIAT), and the International Rice Research Institute (IRRI).

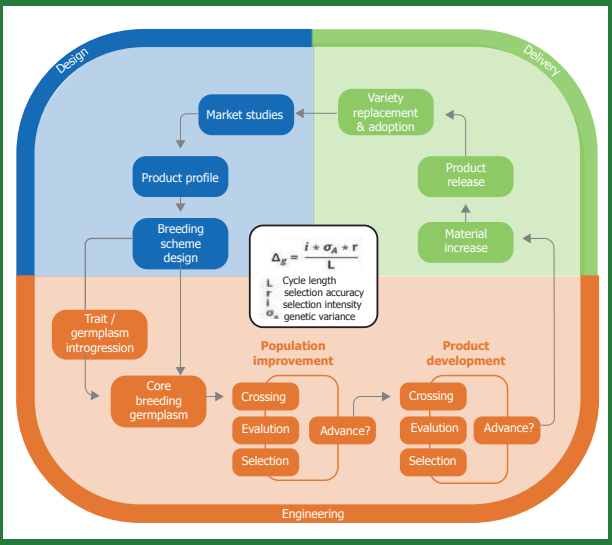
The goal of GRBP is to enhance the quality of life for small-scale rice farmers and consumers in developing regions. The initiative harnesses collective global scientific expertise and resources to efficiently provide locally adapted germplasm and rice products in response to market demands. By synergizing their respective competencies and aligning work plans, the program envisions achieving broader impact across AfricaRice, CIAT, and IRRI.

Operating within the framework of the One-Rice strategy (Figure 1), GRBP is situated under the Plant Breeding and Pre-Breeding Unit of the CGIAR Genetic Innovation Science Group. Here GRBP employs a governance structure with a Core Team composed of interdisciplinary scientists from the three centers. This team advises the Leadership Team in establishing strategic directions and goals. On the Leadership Team, a representative from each center oversees the overall functioning of the program, alongside a GRBP lead appointed by the Genetic Innovation Science Group. An Execution Team encompasses the researchers and breeders involved in all the stages of rice breeding, from market intelligence collection and product design to executing product development plans for the breeding pipeline, seed delivery, and seed systems research.

The three centers are adopting common terminologies to facilitate communication, information exchange, and joint planning, as well as sharing various breeding platforms like the Market Intelligence Platform, Breeding Portal, and Enterprise Breeding System. Moreover, there will be unrestricted sharing and utilization of breeding materials, technologies, market information, and other data. Participants will share services when most cost-effective and embrace a culture of transparency, continuous improvement, and the exchange of good practices and learnings.

Putting GRBP into operation will start with a collaborative prioritization of market segments and the establishment of a shared breeding strategy and framework covering native traits, germplasm development, and associated services. GRBP will collectively reinforce regional and subregional NARS partnership networks, and is committed to improving the performance of research teams and their NARS partners through capacity building. The program will adopt standard reporting approaches, as harmonization is a crucial factor to optimize the use of global resources, capacity, and competencies.

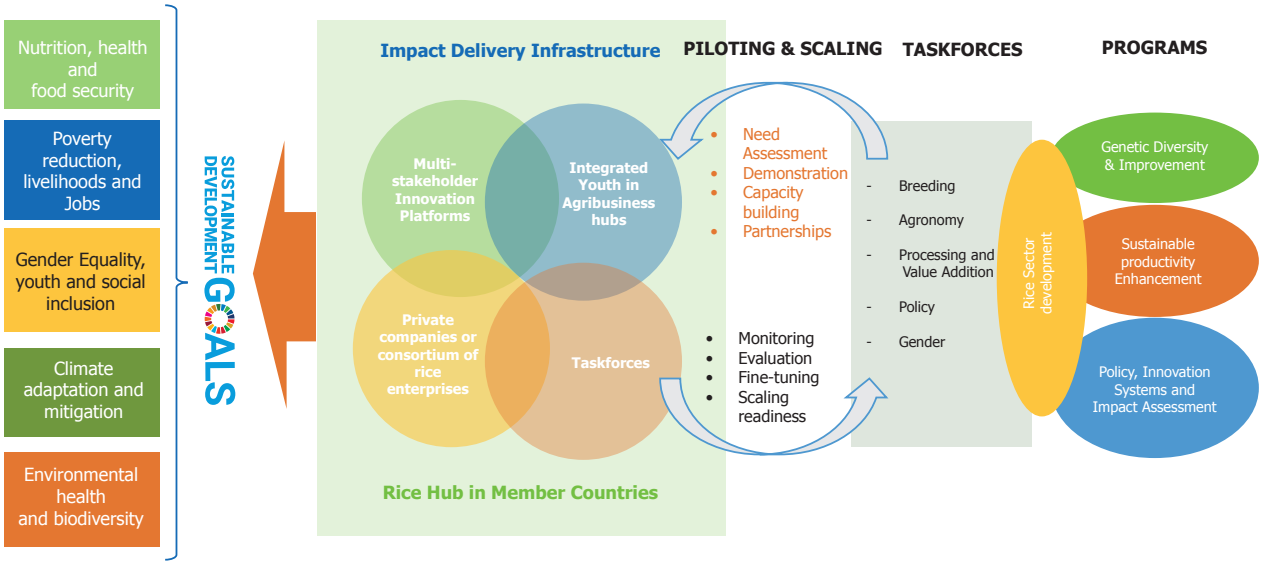
Figure 1. The foundational principles of the One-Rice strategy that governs the Global Rice Breeding Program



Rice Sector Development (RSD) program

The mission of the RSD program is to pilot and scale rice-based innovations to support the transformation of agri-food systems. Seeing AfricaRice's core innovations as part of innovation packages, RSD supports us to understand what investments and partnerships are required to scale core innovations in different contexts and for different types of clients. It interacts with the other research programs and thematic task forces to identify innovation packages, evaluate readiness to scale, and proceed to scaling or adaptation to improve scalability. Scaling is done through the impact delivery infrastructure within hubs, which include multistakeholder innovation platforms, integrated youths in agribusiness hubs, private companies or consortia of companies, as well as organized farmers and processing groups. RSD contributes to the five CGIAR impact areas as seen on the left side of Figure 2.

Figure 2. Outline of Rice Sector Development program operations and linkages with other programs and its impact delivery infrastructure



In a new report, RSD has identified 16 core climate-resilient innovations. These include resilient varieties of both inbred and hybrid lines, agronomic practices, and post-harvest practices. The report has allowed AfricaRice to partner with the African Development Bank (AfDB) to develop a Climate Action Window proposal.

RSD also determined the readiness to scale of 46 healthy diet innovations identified from 21 consortium partners of the HealthyDiets4Africa project. Ten innovations have both high readiness to scale and innovation use level, suggesting they can improve the production, processing, marketing, or consumption of healthy diets if scaling efforts are made. These range from improved snail production techniques to systems for intercropping upland rice with vegetables. HealthyDiets4Africa further supported the establishment of five diversified healthy diet living labs in West Africa. Between these labs, 100 youths and women registered with integrated agribusiness hubs across Africa trained on the production, processing, and commercialization of healthy foods.

In particular, scaling of the Mini-GEM parboiling innovation package (page 20) in Côte d'Ivoire, Mali, Madagascar, and Senegal has improved the availability of high micronutrient and lower glycemic quality rice. The Mini-GEM parboiler uses rice husks

instead of wood as fuel, reducing deforestation, emissions, and smoke effects on the health of parboilers. During the year, 24 GEM systems were deployed and some 1,200 metric tons of parboiled rice were sold to 42,500 consumers. Meanwhile, under the Zero Hunger project in Nigeria, 12,831 rice growers, 65 community-based seed producers, 68 lead farmers, and 115 extension agents trained on relevant practices and services. The project also trained women to add nutritional and economic value to rice by creating rice-based products. And in Liberia under the integrated Rice–Fish Farming System project, farmers received both improved rice foundation seeds and fish fingerlings (page 35).

The Technologies for African Agricultural Transformation phase II (TAAT II) Rice Compact took part in a Rice Symposium in Liberia and a Policy Dialogue in the Gambia, bringing together hundreds of stakeholders to develop clear road maps for attaining rice sovereignty. In Sierra Leone, the harmonization of the seed road map was completed, and similar initiatives are planned in seven other Rice Compact focus countries. Seventeen AfDB and Development Partners country programs are mainstreaming TAAT II technology components into project documents and implementation. The TAAT II Rice Compact is supporting 14 Africa Emergency Food Production Facility operations implemented in 10 Agricultural Development Fund regional member countries.

The Rice Compact is working with SeedEqual and RiceFinder to link AfricaRice's breeding program to national seed systems. The partners introduced 15 hybrid line varieties in Côte d'Ivoire, Ghana, Mali, Nigeria, and Senegal to be evaluated by NARS and private seed enterprises. In the Democratic Republic of Congo, they provided 40 breeding lines for screening experiments in upland, lowland, and highland ecologies. Climate-smart agricultural technologies are also being brought to farmers in the six countries, with a training course for seed enterprise and another on good agricultural practices and post-harvest practices in each country, reaching a combined total of 12,000 seed actors and rice producers. Private seed companies were contracted to produce a total 9,600 metric tons of certified seeds across the six countries in 2024.

Auto CO_2-generating hermetic storage cocoons to protect rice after harvest

Rice stored in unsealed conditions in the tropics is highly vulnerable to insect infestations, rodent attacks, loss in quality, and dangerous mycotoxin contamination. Mycotoxins are substances created by fungi that infect plant material, and above certain concentrations they are toxic to people. Mycotoxin-producing fungi grow under conditions of high temperature, high humidity, and low CO2 levels. In a recent survey, 70% of samples bought from markets across Africa were contaminated with aflatoxin, the most common type of mycotoxin. There is an urgent need to minimize the risks of infection and contamination throughout the value chain, as well as to protect rice quality in storage.

AfricaRice scientists have therefore tested auto CO2-generating anti-rodent hermetic storage cocoons equipped with solar-powered monitoring systems to maintain the conditions that are best for stored rice and worst for fungi. It was important in this research to establish how suitable the technology could be at a small scale, because smallholder women farmers and processors—who store the harvest for weekly marketing to sustain their lives—are the most affected by storage losses in rice quantity and quality.

For the tests, anti-rodent platforms were installed with the participation of three women's multistakeholer platforms selected in humid, semi-humid, and arid zones. Cocoons storing 5 metric tons of rice each were sealed on the platforms, and the monitoring systems set up to record data on temperature, humidity, and CO2 levels every hour.

By the end of 2023, data had been collected for 12 months in the semi-humid zone (Figure 3) and 6 months in the humid zone (Figure 4). In both cases, temperature and relative humidity in the cocoon has remained largely stable, except for occasions when the cocoon was opened to test the condition of the rice. The cocoons also generated a steady elevated CO2 level of 5%. On occasions when CO2 decreased or humidity increased due to a valve leakage, this was detected in real time using the monitoring dashboard (Figure 5) and corrected.

While the tests are ongoing, thus far the rice stored in the cocoons has maintained its original moisture content of 13–14%. No rodent, insect, or fungal activity has been observed, and no mycotoxin contamination has been detected—contrary to what has been seen in check samples stored nearby, which were packaged in woven nylon bags under more typical conditions. The quality of milled rice coming from the cocoons remains equally high across the humid, semi-humid, and arid zones. This early evidence of the innovation's advantages has been exposed to about 500 value-chain actors who are members of different multistakeholder platforms in Africa.

Auto CO2-generating anti-rodent-hermetic storage cocoons with solar-powered monitoring installed with the Bouaké Multistakeholder Innovation Platform

Figure 3. Temperature, relative humidity and carbon dioxide levels in auto CO_2-generated anti-rodent hermetic storage cocoons installed in the semi-humid agroecological zone (Bouaké) in Côte d'Ivoire

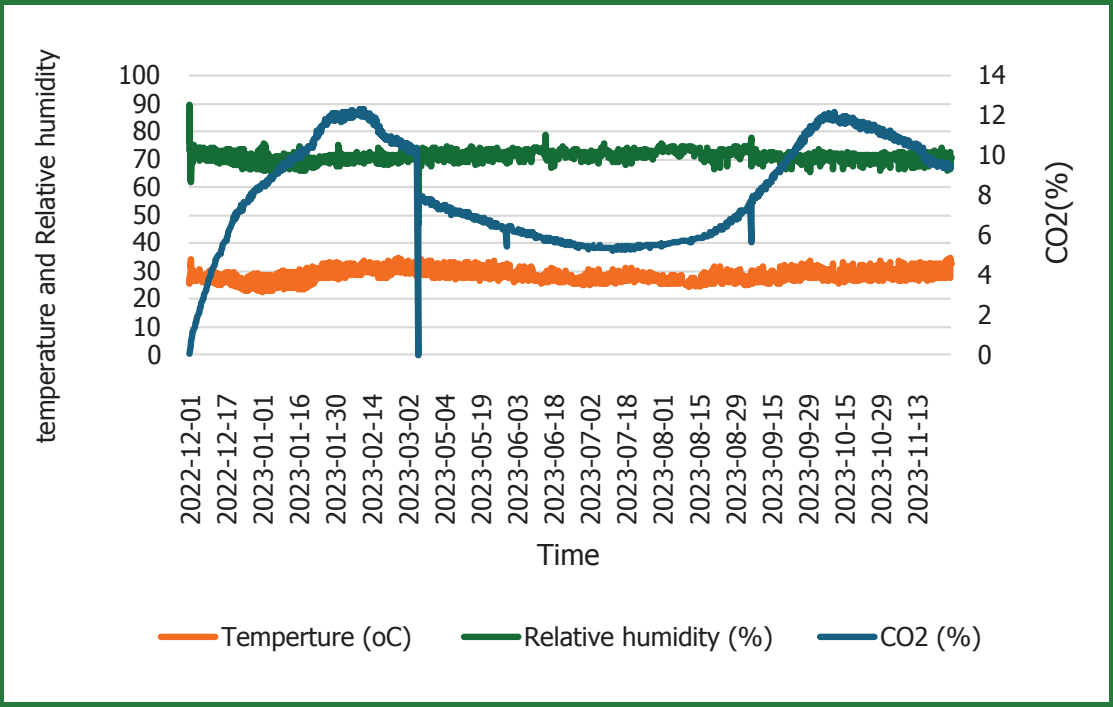
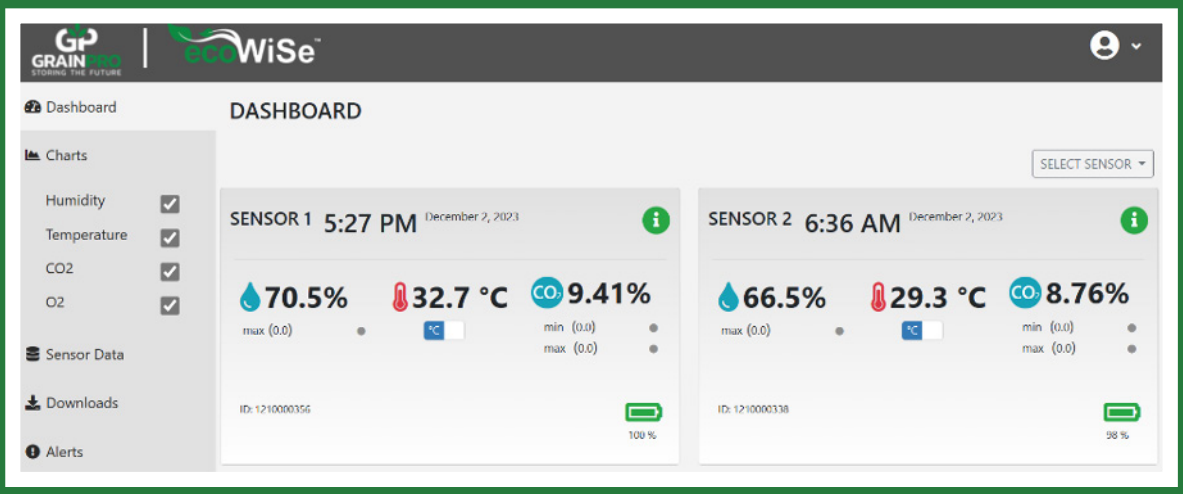


Figure 4. Real-time Ecowise® monitoring system dashboard for auto CO2-generated anti-rodent hermetic storage cocoons installed in the semi-humid (Sensor 1) and humid (Sensor 2) zones in Côte d'Ivoire



History of the AfricaRice Breeding Task Force

The AfricaRice Breeding Task Force is a collaborative research effort for rice development across Africa. Its principles are partnership, sustainability, critical mass, and NARS ownership. In fact, IRRI established the International Rice Testing Program in 1975, and the West African Rice Development Association (WARDA) supervised the first varietal trials in 1981, with Dr. Sié Moussa serving as the trial coordinator. In 1982, the International Rice Testing Program provided WARDA with genetic evaluation and utilization training, and in 1990, WARDA established nine task forces, including four breeding task forces for upland, rainfed, lowland irrigation, and mangrove use.

In 1991, the International Rice Testing Program changed its name to the International Network for Genetic Evaluation of Rice. Its job was to test advanced pre-variety breeding lines created by IRRI's rice breeding programs and NARS partner organizations that do rice breeding and research on a global scale. The Breeding Task Force was also launched in 1991 to facilitate cooperation among breeders in West and Central Africa, and in 1992, the four breeding task forces merged under the single Breeding Task Force chaired by Dr. Sié Mousa. In 1996, the regional organization CORAF sponsored, and WARDA coordinated, rice network trials in Benin, Burkina Faso, Cameroon, Chad, Côte

d'Ivoire, Mali, Senegal, and Togo. Then, for greater efficiency on the ground, the two rice networks of WARDA and CORAF were combined into a single network.

In April 2000, following the 1998 National Experts Committee of Agriculture, CORAF and WARDA amalgamated the WARDA Task Force with the CORAF Rice Network to create a single network of Rice Research and Development in West and Central Africa (ROCARIZ). In 2001, WARDA hired a full-time coordinator for ROCARIZ and held a Steering Committee meeting. During this conference, the 2001 plan and budget were approved, and minor research grants were distributed to NARS researchers. In total, 59 NARS researchers from 14 countries in West and Central Africa completed two-year studies.

In 2003, WARDA was renamed AfricaRice. At the end of 2007, the project Stress-Tolerant Rice for Africa and South Asia, funded by the Bill & Melinda Gates Foundation, was started by IRRI in collaboration with AfricaRice to develop and deliver rice varieties that are tolerant to abiotic stresses for the millions of farmers in rainfed rice-growing environments in Asia and Africa. This project funded breeding trials and seed multiplication in more than 14 African countries from 2007 to 2017 and was coordinated at AfricaRice by Dr. Manneh Baboucarr.

In 2010, the Africa Rice Congress advocated for the restoration of WARDA's successful task force model from the 1990s. Today, the Breeding Task Force aims to speed the development and deployment of the next generation of elite rice varieties for major production systems in sub-Saharan Africa. The goals are to implement a collaborative approach to rice breeding; improve access to new materials for African rice breeders; promote rice germplasm evaluation across the continent; and reduce the time required for deploying new rice varieties in major production systems in sub-Saharan Africa.

The Breeding Task Force endeavors to conduct rice Research for Development across Africa, and it includes representatives from all 28 AfricaRice member countries' NARS. AfricaRice breeders aim to boost rice production in four specific ecologies (rainfed upland, rainfed lowland, irrigated, and high elevation) throughout the region. In terms of achievement, AfricaRice and its collaborators have supplied some of the NARS with weather stations, moisture content meters, tablets, and electronic scales for effective data collection via the Task Force network. AfricaRice's 18 upland and 60 rainfed lowland NERICA varieties, and the 18 ARICA varieties created by AfricaRice and NARS partners, serve to increase productivity and improve farmer incomes across Africa.

From 2011 to 2023, 352 varieties were released in African countries, and NARS breeders' skills grew stronger through trainings in field management, data gathering, data analysis, and seed production. The Task Force can now capitalize on NARS breeders that have successfully defended their theses (10 PhDs and 12 master's degrees). Having made these accomplishments, the Task Force continues to face new challenges such as the adoption of Task Force trials by national programs through self-funding, the integration of hybrids into the Task Force network, the identification of new sponsors for new projects, and the equipping of NARS facilities.

Enhancing rice breeding efficiency through the genomic selection approach

Genomic selection uses associations between genetic markers and plant phenotypes to forecast the breeding value of individuals. This approach can be implemented early in the breeding cycle, reducing the generation interval and consequently amplifying genetic gain over time. The advent of cost-effective, high-throughput genotyping platforms has enabled the integration of genomic selection on a scale necessary for meaningful impact, and by doing so has transformed plant breeding initiatives.

This technique is a focus of the BMGF-supported Accelerating Genetic Gain and Varietal Replacement in Rice – Phase 2 (AGGRi-2) project, which aims to accelerate genetic gain and varietal replacement in rice. A comprehensive study was conducted under the project to investigate 958 stage 1 (early generation) breeding lines from rainfed lowland breeding program, targeting various traits such as grain yield, plant height, days to flowering, and days to maturity. The study considered trials from multiple environments such as Ibadan in Nigeria, M'bé in Côte d'Ivoire, and Ndiaye in Senegal, all conducted in the wet season of 2023.

The traits under investigation exhibited a diverse range of heritability. Genomic prediction models were established for these using a Bayesian methodology, and 805 genome-wide single-nucleotide polymorphisms (SNPs) were used to compute a genomic relationship matrix and heatmap (Figure 6). Principal component analysis was performed on the matrix, revealing that genotypes can be clustered in three main groups (Figure 7). The three clusters highlighted around 115, 200, and 450 sibships respectively. There were also interesting relationships in the off-diagonal, denoting a good connectivity between individuals from different families.

Genetic correlations were positive between environments irrespective of traits, indicating that different environments can be combined when estimating breeding values. Therefore, combined data from all environments was used in the computation of genomic estimated breeding values. Pearson correlation was employed to access the prediction accuracy of genomic selection for specific traits, and this showed a prediction accuracy consistent with the values reported in literature for rice and other crops. In this case, genomic selection achieved a prediction accuracy of 89.8% for plant height, 73.6% for days to flowering, 69.2% for days to maturity, and 51.8% for grain yield through the methodology of genomic best linear unbiased prediction (gBLUP). These scores indicate high levels of selection accuracy, suggesting that breeders can achieve a higher rate of genetic gain by using genomic selection for these traits in rice.

Hence, the utilization of genomic selection-led parental selection with early generation breeding materials is expected to deliver superior genetic gain compared to the previous practice of non-genomic BLUP-based selection conducted with later generation breeding lines.

Figure 5. Heatmap based on genomic relationship matrix of 958 early generation rainfed lowland rice breeding lines

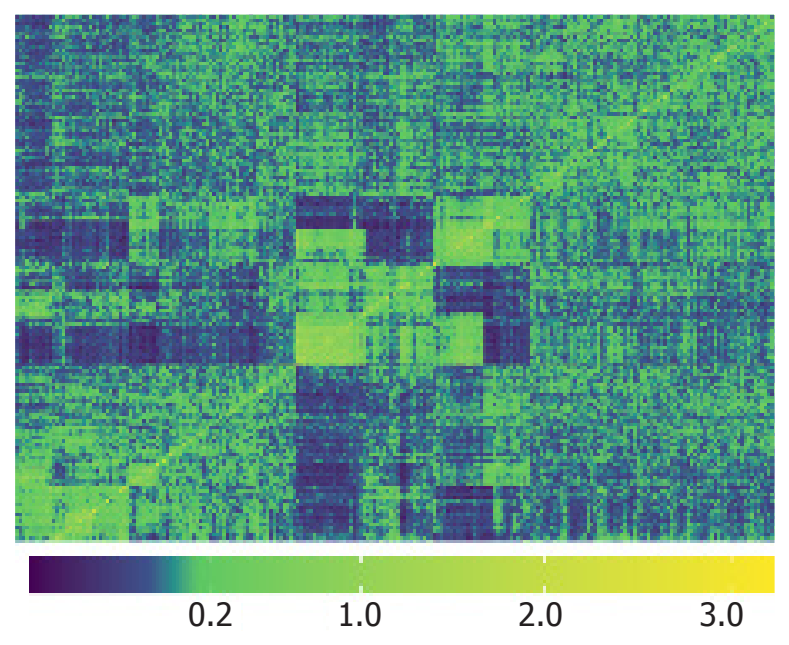
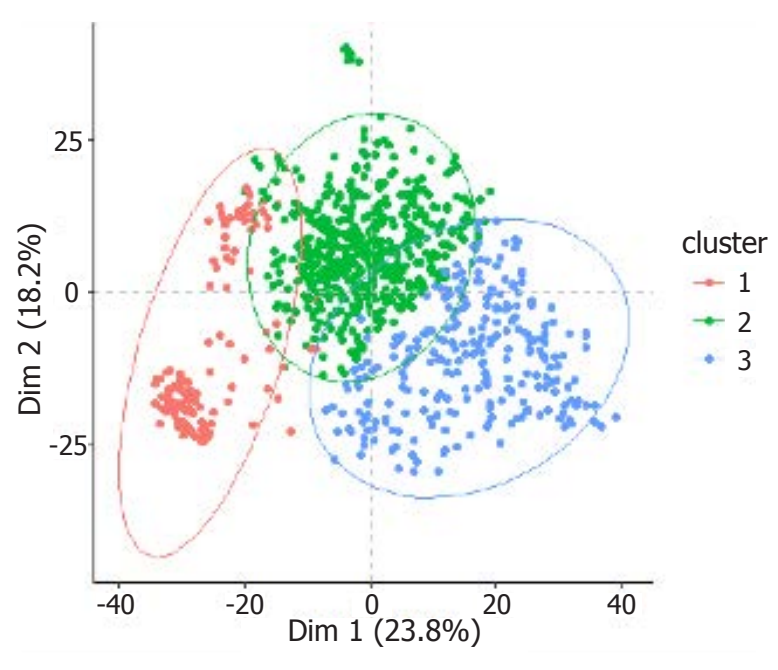


Figure 6. Principal component analysis plot based on genomic relationship matrix of 958 early generation rainfed lowland rice breeding lines



The Rice Biodiversity Center for Africa

The AfricaRice genebank holds the third-largest rice collection in the world, after IRRI in the Philippines and the Dale Bumpers National Rice Research Center in the United States. Furthermore, it has some of the largest indoor and outdoor facilities in Africa that are accessible to partners in the region for germplasm conservation, safety backup as black box, regeneration/rejuvenation, and characterization. The AfricaRice Board of Trustees has approved an expansion of the genebank's mandate in rice conservation in Africa and upgraded the genebank to the Rice Biodiversity Center for Africa (RBCA).

The modern RBCA in M'bé, Côte d'Ivoire has state-of-the-art facilities and land for germplasm regeneration, evaluation, and characterization. Depending on the type of collection (working collection, active collection, or base collection), the RBCA conserves rice seeds under medium-term and long-term storage conditions. The genebank now has the capacity to accommodate up to 60,000 medium-term and 50,000 long-term accessions. The drying room can dry up to 1 metric ton of new harvested material, shortening the time between harvest and storage and increasing seed longevity. Spacious laboratory space facilitates seed processing, viability testing, and lab-based seed characterization using an innovative artificial intelligence technology called Videometer.

With these facilities, it has now been possible to relocate the entire AfricaRice collection conserved in medium-term storage from Cotonou, Benin, and the collection in long-term storage from the International Institute of Tropical Agriculture in Ibadan, Nigeria, to our new genebank in M'bé. The relocation was also an opportunity to conduct a complete inventory of the whole medium-term collection, unpack and re-dry the accessions, and repack each into new aluminum foil packets with barcodes.

We have made tremendous efforts to improve the quality of our operations and minimize errors, which includes making standard operating procedures available for all genebank operations, compiling policy guidelines, and producing a quality management system manual including a risk and mitigation book. Innovative technologies for seed management are being used to reduce the time required between seed harvest and conservation. Genomics tools minimize sample misclassification and mislabeling. A fully digital genebank will facilitate future physical seed authentication, and we have successfully implemented a barcoding system with a handheld scanner to read labels in all genebank operations, including all field and lab activities, and perform data entry on tablets. The staff are qualified and were trained in quality management systems, seed management systems, improvements in genebank operations, data curation, and data entry in GRIN Global Community Edition.

The RBCA staff developed 11 subsets of rice collections based on traits and genomic information that may help in promoting the use of the genebank for research, breeding, and education. The subsets include accessions that are tolerant to drought, iron toxicity, submergence, anaerobic germination, and stagnant flooding; accessions that are resistant to rice yellow mottle virus, African gall midge, and bacterial blight; and the most widely distributed accessions of the last 25 years.

The RBCA has demonstrated remarkable dedication to germplasm distribution, characterized by the provision of representative samples from our genebank collection in response to user requests. Over the past five years, the AfricaRice genebank has successfully dispatched a total of 17,536 registered samples to research institutions and non-governmental organizations in more than 90 countries. Notably, 30% of these seed samples have gone to CGIAR scientists, while 53% were sent to NARS partners. The annual average for the number of seed samples shipped during this period reached an impressive 3,507 samples. This robust distribution effort signifies our commitment

to sharing valuable genetic resources on a global scale.

The RBCA made a significant contribution to knowledge sharing this year by publishing 11 research papers in international peer-reviewed journals and 3 book chapters. It stands as a pivotal regional asset for knowledge and capacity building, serving not only as a repository of genetic diversity crucial for rice research but also as an educational platform that nurtures partnerships and cultivates local talent. Through its commitment to knowledge sharing, the genebank plays a vital role in training scientists, particularly those from national genebanks across Africa.

Furthermore, the genebank extends its influence to the academic sphere, providing students, both at the master's and PhD levels, with the chance to glean insights and find guidance. These initiatives contribute not only to the enrichment of knowledge but also to the clarity of career paths for aspiring researchers, thereby strengthening the scientific community's capacity for sustainable rice production in the region.

Rice Seed Service Unit

The Seed Unit at AfricaRice produced a total of 31 tons of seeds in 2023, comprising breeder seeds, which includes 1 ton of hybrid (F1) seeds. AfricaRice is providing strategic backup in the seed value chain through our seed production initiative. This ensures that there is a last resort for running the entire seed value chain.

In its seed scaling activity, the Seed Unit disseminated mainly breeder seeds, including hybrids, to 10 seed enterprises in five countries. In Côte d'Ivoire, three seed enterprises received 14 varieties; in Madagascar, one seed enterprise received 4 varieties; in Nigeria, three seed enterprises received 27 varieties; in Senegal, three seed enterprises received 27 varieties; and in Uganda, one seed enterprise received 4 varieties. Five NARS partners in Côte d'Ivoire, Ghana, Mali, Nigeria, and Senegal also received a set of 25 genotypes for evaluation. Seeds received by enterprises were used to enhance awareness of the private sector on new improved and climate-smart rice varieties. This was carried out through demonstration plots and field days showcasing the performance of these varieties. In this regard, AfricaRice is contributing to the creation of effective demand for seeds of these varieties and thereby aiding the establishment of a sustainable private sector-led seed system.

The Seed Unit at AfricaRice also undertakes capacity building of stakeholders of the rice seed value as a principal activity. The unit in conducted two regional trainings this year on rice seed production, marketing techniques, and management of seed enterprise - The first of these trainings was conducted in the framework of the Transition Support Fund, an AfDB-funded program. The training took place at the AfricaRice Sahel Station in St. Louis, Senegal from 17 to 21 July 2023. The regional training workshop increased the skills of participants from five countries belonging to mainly small to medium seed enterprises. A total of 21 participants, including two women, attended the training. The participants were from the following countries: Burkina Faso, Gambia, Guinea-Bissau, and Liberia. The training also served as a forum for exchange and sharing of experiences. The objectives of the training were achieved, as the post-course evaluation showed an increase in the knowledge of each participant.

The second regional training was conducted in the framework of the KAFACI project, targeting KAFACI and K-Belt countries. Again, taking place at the AfricaRice Sahel Station in St. Louis, Senegal, this training ran from 13 to 18 November 2023. A total of 18 participants, including three women, attended the training. Participants were from Gambia, Ghana, Guinea, Malawi, Senegal, and Uganda. Here, too, the post-course evaluation showed that participants enhanced their knowledge on seed production, marketing, and enterprise management.

The Seed Unit has also collaborated with the company Da-All Green Seeds Limited of Nigeria within the period of 2020-2023. AfricaRice has engaged in this collaboration to conduct demonstration and field trials of several rice varieties that possess high yielding, climate-smart, and good grain quality attributes. These trials are geared toward identifying varieties suitable to the prevailing conditions in Nigeria for improved productivity while mitigating the effects of climate change. In 2023, AfricaRice and Da-All Green Seeds Limited conducted trials, demonstrations, and field days. Table 2 presents comments and remarks from some of the farmers who participated in the demonstrations and attended the field days.

Table 2. Remarks on varieties from farmers participating in demonstrations and field days in Nigeria

Ecology	Variety	Remarks
Irrigated	AR708H AR606H AR051H AR647H	AR606H and AR647H have higher yield potential, as commented by the farmers.
Lowland	ARICA 6 FARO 61 FARO 66 FARO 67	The four varieties had great performance, and with an average yield of 6.7-10 tons per hectare. Farmers had a high preference for FARO 67 due to its flood tolerance capacity.
Irrigated	ADV 8100 SK 2304 H SK 2306 H PAC 807 ISRIZ 07 08Fan2 AR606H Sahel 210 IR107015-6-5-3-1 SK 2308 H ISRIZ 09 CY2 ADV 18003 Egyptian Jasmin PAC 801 SK 2307 SK 2303 H ISRIZ 12	PAC 801 and SK 2307 H were recorded as the farmers' choice for their high yields and good panicle development.

Sustaining and enhancing rice yields in the face of climate change

Climate change is already manifesting all over Africa, as evidenced by elevated temperatures, heightened weather variability, and an increase in extreme weather events. Rainfall patterns have become more intense, marked by seasonal droughts and heavy downpours during the rainy seasons, leading to more frequent and severe floods and flash floods. The impact on rice-based systems is severe, resulting in a 24% loss in rice yield and a decline in land suitability for rice cultivation by over 50% projected for 2070 compared to the baseline in 2000. Given that rice is the second most crucial source of calories in the region, the repercussions of climate change on rice production could lead to food and nutrition insecurity unless farmers adopt effective adaptation measures.

AfricaRice and its partners have developed and validated climate-smart technologies designed to sustain and enhance rice yields in the face of climate change. These technologies include climate-smart rice varieties that exhibit tolerance to drought, cold, submergence, salinity, and heat stresses, resulting in substantial increases in rice yield compared to farmers' traditional varieties.

In irrigated lowlands, practices such as the System of Rice Intensification, alternate wetting and drying, and mid-season drainage have proven effective in reducing water use by 15–43% and increasing water productivity by 8–87% while maintaining rice yield compared to continuous flooding practices. A combination of salt-tolerant varieties and NPK, gypsum, or zinc fertilizer increased rice yield by 0.8 behcig tons per hectare and net profit by US$ 107 per hectare.

In rainfed lowlands, the Smart-Valleys approach for inland valley development has boosted rice yield by 0.9–2.4 tons per hectare and farmers' net income by US$ 267–1,157. Additionally, solar-powered irrigation has increased farmers' net income by US$ 5,262 per hectare per year.

In rainfed uplands, employing no-tillage in conjunction with soil mulching has led to a 1.3 tons per hectare increase in rice yield. The digital application RiceAdvice, tailored for location-specific sustainable rice cultivation, has increased rice yield by 0.3 tons per hectare and farmers' income by US$ 120 per hectare compared to the recommended fertilizer application.

The future trajectory of climate change research at AfricaRice will see scientists focusing on many different, parallel efforts. This will include developing rice varieties that are ready for climate change, promoting direct-seeded rice, exploring diversified farming systems, establishing climate-resilient rice landscapes, monitoring and mitigating greenhouse gas emissions, mapping the suitability of climate-resilient technologies, assessing adoption impacts, and conducting foresight analyses. Additionally, efforts will be directed toward formulating conducive policies for the adoption of climate-resilient technologies, processes, and procedures.

Gender equality and social inclusion

Women and youth are provided with equal opportunities to engage fully in value chain activities and to enjoy the benefits.

STORY

Barriers to the adoption of climate-smart technologies in rice cultivation by women: a perspective from Mali

Scaling up and adoption of climate-smart technologies helps to sustain agricultural gains and foster crop adaptation and resilience to climate change. However, significant barriers faced by vulnerable stakeholders, including women, to adopting technologies curtail the effectiveness and efficiency of these innovations.

The challenges facing women rice farmers are growing, and they vary from limitations in production methods to insufficient access to productive resources. Women more often than men depend on natural resources for their livelihoods, lack financial capacity, and cannot gain access to innovative techniques to overcome their challenges. Socially based inequality limits their access to climate-smart and gender-responsive technologies. Women are given low quality land where flooding and drought persist.

These women often feel demotivated, and thus they are reluctant to embark on the adoption of new farming methods and invest in climate-smart agriculture and climate information services. They also fear the consequences of land expropriation; therefore, they most often register for agricultural insurance to prevent this danger.

Limited access to some inputs like improved seeds suitable for their poor-quality land, fertilizers, and pesticides is a significant constraint. In addition, women come second in terms of extension services. And conditionalities for accessing formal credit constitute major financial constraints that limit their ability.

Dissemination and adoption of climate information services seems necessary to mitigate some of the worst impacts of climate change on women rice farmers. Women require the right literacy to independently access information on climate and new agricultural techniques. In this way, climate information services will make them well informed on weather conditions and forecasts, and thus improve their agricultural planning and awareness of climate change-related risks. It is also necessary to support more women in building leadership skills and self-confidence to facilitate their participation in cooperatives and farmers' organizations and their mainstreaming in climate change programs and projects.

A baseline study by the Advancing Climate-Smart Agriculture Technologies in Africa project suggests that it is necessary to begin addressing the gaps and challenges that women rice farmers face with interventions and strategies that boost their access to better rice seed and mechanization. A lot of external effort from government extension services and other development partners is needed to boost their awareness of climate-smart agricultural practices. Awareness of gender-responsive technologies, too, should enable women to participate in rice farming as more central actors and contribute to more widespread adoption of climate-smart practices.

Persistence of gender inequalities in access to land in the rice sector: a perspective from Ghana

Although women farmers in sub-Saharan Africa are an essential link in food production and, in turn, in reducing local food insecurity, they still suffer from profound inequalities compared with men. As part of the CGIAR Initiative for the Transformation of Agrifood Systems in West and Central Africa, a qualitative study was carried out to understand the challenges to women's empowerment in the rice and agricultural sector in Ghana.

Data for the study was collected from farmers and community leaders in the three rice-producing areas of Tain District, Ahafo Ano South West District, and Ahafo Ano South East District. The results focus in particular on the social causes of gender inequalities in access to land in the rice-growing sector. It emerges that women have limited access to land, even though they play an essential role in rice production.

Although in theory they have the same rights as men in Ghana, very few women own land. This situation is linked to the way in which land is regarded as a family asset over which women have no absolute right, since they are obliged to go and live with their husband's family. Society assumes that a woman's ownership of land can change in favor of her husband if he divorces her or marries another woman. To avoid such a scenario, only the men have exclusive control over the family land.

The persistence of these ideas prevents women from inheriting land from their husbands or male relatives. This explains why the majority of women rice growers in Ghana have only secondary and insecure access to land. As a result, many gradually lose interest in farming and, above all, their socio-economic and living conditions become more fragile.

It is therefore by maintaining an inclusive dialogue on social norms with stakeholders that the conditions of women farmers can be improved and have an impact on the fight against inequalities in the agricultural sector in Ghana.

Profitability of rice depends on nitrogen rate, nitrogen source, and the growing season in southwestern Madagascar

Fertilizers are vital for increasing rice productivity and improving food security in sub-Saharan Africa. But recent high prices for inorganic fertilizers, together with low prices paid for rice at the farm gate, have disincentivized inorganic fertilizer application among resource-poor smallholder farmers in countries such as Madagascar. They have pushed these farmers to use only locally available organic inputs. While combinations of both inorganic and organic inputs could be a feasible third option for farmers, their effectiveness on yield and profitability still needs to be quantified.

The objective of this study was to quantify the benefits to yield and profitability of using different combinations of inorganic and organic fertilizers, providing different levels of nitrogen (N), to identify the optimal utilization of these fertilizer sources for increased profitability. Five field experiments with three replications each were conducted for two consecutive seasons (wet and dry) in Madagascar. A set of 10 treatments per experiment included a control, three N levels (30, 60, and 90 kilograms per hectare) with inorganic or organic fertilizers, and three similar N levels with combinations of 50% inorganic and 50% organic fertilizers. Data were collected on yield, yield attributes, and economic variables for the profitability analysis.

Overall, the dry season yield (4.5 metric tons per hectare) was higher than the wet season yield (3.8 tons per hectare). Yield was significantly higher for all treatments than for the control with no fertilizer. Among the three different fertilizer sources at the same N level, yield was highest for inorganic, followed by combined inorganic and organic, and lowest for organic fertilizer. Yield rose with increasing N levels for inorganic and combined inorganic and organic fertilizers in both seasons; however, a similar yield increase was not observed with only organic fertilizer at higher N levels. The incremental benefit-to-cost ratio for fertilizer application was more than 2 only at lower N levels (30 kilograms per hectare) of combined and organic fertilizers, and only in the high-yielding dry season.

Higher yields with inorganic N fertilizer did not transform into increased profit for smallholder farmers, given the high price of the input. This illustrates why farmers do not have incentives to apply inorganic fertilizer and increase their yields. Under the current fertilizer and rice price regime, however, the application of lower N levels with a mix of inorganic and organic fertilizer, or with only organic fertilizer, can be profitable—at least in the dry season.

Transforming Liberia's agriculture: Government and European Union applaud success of integrated rice and fish farming

The Integrated Rice–Fish Farming System project is an EU–funded project in Liberia aiming to enhance the development of rice and fish value chains for improved food, nutrition, and economic security through targeted research and extension approaches. It is part of Development Smart Innovation through Research in Agriculture (DeSIRA), an EU initiative to transform food systems in low- and middle-income countries. The rice–fish system has such a transformative potential: it has introduced to Liberia integrated rice fields and rice field/pond complexes where fish are raised during or between rice seasons. Fish may be deliberately stocked, or they may enter fields naturally when surrounding waterways flood.

AfricaRice and WorldFish implemented the project between 2020 and 2023 in partnership with Liberia's National Fisheries and Aquaculture Authority, Central Agricultural Research Institute, and Ministry of Agriculture. Agriculture is the primary source of income for 80% of Liberians, but rice farmers face many challenges, and Liberia still imports rice and other major commodities to feed its growing population. On average, the country imports 300,000 tons of rice annually, costing an estimated US$ 200 million.

Through this project, farmers learned how to grow rice and fish together in fields and ponds, contributing to a better utilization of land and increase of their income. The system has been implemented in five counties of Liberia to increase the national capacity to conduct research on rice–fish systems, the coverage of extension services to such integrated systems, the income of farming households, and the access to and consumption of both fish and rice.
Various supporting innovations have been disseminated, including climate-smart technologies in rice field preparation and pond construction to safeguard against erosion in flash floods; the

improved NERICA L-19 rice variety with its 120–130 day growth cycle; rice ratooning technology that enables farmers to harvest twice from the same rice plant; and locally fabricated agro-equipment for production and processing of rice and fish.

These innovations resulted in major outputs toward the project's targets, with local integrated fish and rice production rising from almost nothing in 2020 to 35 tons of fish and 167 tons of rice in 2023. By the end of the project, 103 women heads of households and 178 young farmers—two of the target demographics—had adopted the new system. A series of workshops have enhanced the capacities of DeSIRA partners, students, and farmers to maximize the benefits of the rice–fish system.

Liberian Government representatives and DeSIRA partners visited the Central Agricultural Research Institute at the conclusion of the project to witness its achievements firsthand, and they all came away with positive feedback and appreciation for the great results achieved. For Augustine Moore, lead farmer of one of the project's beneficiary groups, "integrated rice–fish farming is the way to go because it highly contributes to increased income for farmers. This is what I call taking farmers out of poverty. We have the rice, the fish, and the vegetables. When we are talking about sustainable farming practices for farmers, this is it."

Youth in agribusiness and rice seed production in Nigeria

Youth represent a substantial segment of the global population: according to the United Nations, in 2020 there were 1.8 billion young people between the ages of 10 and 24 in the world. Youth are also considered the agents of social transformation and change-makers of tomorrow. Empowering them with the right technologies, innovations, business skills, knowledge, and opportunities prepares them for transforming agribusiness in agri-food systems.

AfricaRice, in line with the Nigerian government's commitment to reduce youth unemployment and poverty, is creating a new generation of youth seed producers who will revolutionize the Nigerian agricultural sector through rice seed production businesses. In this country, seed mixtures and lack of good quality rice seed have long been major constraints to rice production and food security. The AfricaRice youth entrepreneurship development approach seeks to change those constraints with three pillars of action. First, we are enhancing the technical competence and skills of youth and women in seed agribusiness. Second, we are ensuring significant return on investment, especially when technologies, innovations, and services are combined. And third, we are organizing the effective coaching and mentoring of youth—connecting them with experienced professionals and successful business owners who can provide guidance and support.

In one project under our approach, AfricaRice partnered with the Government of Nigeria and the International Fund for Agricultural Development (IFAD)-assisted Value Chain Development Programme in training 180 youth seed producers in rice seed production businesses across the Nigerian states of Anambra, Benue, Ebonyi, Niger, Ogun, Taraba, Enugu, Nasarawa, and Kogi. The training modules included a series of classroom lectures on the principle of seed production, field practical sessions to provide hands-on experience in the preparation of nursery beds and good agricultural practices, and the setting up of demonstration plots in each of the nine states. Each trained youth was empowered with 50 kilograms of breeder seed from AfricaRice as a starter pack to plant 1 hectare of land. The agribusiness incubation model has benefited from backstopping visits by AfricaRice's seeds team.

This intervention has changed things for good for the majority of the youth—especially the line transplanting method for seedlings, which has doubled their yields compared to the broadcasting method of planting rice. Some of the trained youth seed producers not only supply seed, but also provide out-grower services for industrial rice processors such as Olam International and Popular Farms. Olam International selected one young producer, Sumaiya Amadu, the CEO of Sea Agro Enterprises from Taraba State, as their chief rice seed producer. Ms. Amadu has also received several awards from IFAD Rome thanks to her training with AfricaRice. Reza Agro Services, run by another youth seed entrepreneur from Niger State, sold seed worth US$ 41,667 through a linkage to off-takers in Akwa Ibom State. Peter Okonkwo, a youth seed entrepreneur from Anambra State, has bought a tractor from his sales of rice seed.

AfricaRice has simultaneously pursued our youth entrepreneurship approach in Nigeria under other projects. Through the Youth Employment in Agribusiness and Sustainable Agriculture project, implemented in Oyo and Ekiti States, 53 youth and women were trained and provided with foundation seed and capital to become seed producers. Some of them are today marketing their seed to farmers in these and neighboring states. Under the Zero Hunger project implemented in Ebonyi State, 200 youth seed producers were trained on digital extension advisory tools and supported with starter packs of foundation seed to become seed entrepreneurs in their rural farming communities—shortening the distance farmers must travel to source and buy quality improved seed. This has proven itself as a good exit strategy that ensures youth remain in profitable and sustainable businesses contributing to job creation beyond the life of seed intervention programs.

With projects like these, AfricaRice has showcased the enormous business opportunities that abound along the rice value chain, and the socio-economic benefits of integrating the divergent but complementary individual skills and abilities of young people into the agricultural sector.

Empowering vulnerable women and young agripreneurs in Senegal with social recognition and power

The Mastercard Foundation funded the Rice Agripreneurs Project in Senegal from 2020 to 2023 in order to enhance the resilience of vulnerable women and develop youth entrepreneurship during and after the COVID-19 pandemic. The project supported vulnerable farmers—with 77% being women—by distributing over 1,000 input kits covering certified seeds, fertilizers, and irrigation costs. The project also provided technical training to 313 young individuals and youth groups in five important areas: entrepreneurship and personal development; integrated management of paddy and seed production; processing and marketing; mechanized service provision; and supply chain management.

The project provided additional financial support to 100 individual young entrepreneurs and youth groups, including 50% women, which has enabled the implementation of highly profitable activities along the rice value chain, from seed and paddy production to processing and service provision. The project not only facilitated the creation of 4,937 jobs, but also ensured that 64% of these job opportunities were made available to women. Additionally, the project played a crucial role in enhancing the professional competencies and social welfare of the beneficiaries.

Aby Kane, President of the group Women of Ndiatène, declared, "thanks to the kit, we were able to successfully cultivate 13 hectares of rice, which allowed us to renew our partnership with the national agricultural bank, La Banque Agricole, allowing us to expand our operation to 30 hectares during the following cropping season. Our family farms have seen significant improvements, both in terms of yield and profitability. We are grateful for the support and resources provided by the project, which have been instrumental in helping us achieve our goals and sustain our livelihoods."

Seynabou Niang, a young agripreneur from the village of Ross Béthio, started as a local juice trader before the project. "With the profits from processing 15 tons of paddy acquired thanks to the project, I renovated my room, purchased a new bedroom, and invested in a good freezer for my juice business," she recounts.

According to Khady Sow, another young agripreneur from Rosso Senegal, "this project has greatly improved our living conditions. Prior to receiving funding, I did not have a wardrobe to store my clothes. Now, I have purchased a wardrobe with five compartments. Additionally, I have acquired two bulls and one cow for breeding purposes. I am able now to cultivate ten hectares of land for rice while my entire family could not cultivate more than two hectares before the project."

Other participants in the project have reported a multitude of benefits. The top three advantages perceived by the beneficiaries are the development of the ability to efficiently manage their businesses, reported by 96% of beneficiaries; the adoption of new agricultural practices and knowledge, reported by 91%; and the development of formal relationships with other actors in the sector, reported by 89%. Other benefits they reported include knowledge of new rice technologies, increased income, increased social recognition, self-sufficiency, and access to credit through the national agricultural bank.

AfricaRice with Korean experience: a winning cooperation

Since 2010, the Republic of Korea's Rural Development Administration has been carrying out development cooperation projects in African agricultural technology through its Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI). AfricaRice is working with KAFACI to enhance high-yielding rice germplasm, as well as breeding capacity in rice-producing countries, through the African Rice Development Partnership. This is a nine-year, three-phase project being carried out from 2017 to 2025.

Korea, where rice is the staple food, has the valuable experience of having achieved self-sufficiency in rice in the mid-1970s. The country did this by dramatically increasing rice yield per hectare with the Tongil variety, which was created through a cross between the *indica* and *japonica* rice subspecies. In addition, during the continuing development of rice varieties over the past 30 years, more Tongil type rice varieties created by hybridizing indica and japonica lines have proven to increase yields by 10–20% compared to traditional *japonica* varieties.

In Africa, where more than half of the continent's 1.4 billion people rely on rice as a staple food, self-sufficiency is still far away. African countries produce about 21 million metric tons of rice every year, but import another 15 million tons. Average rice production by unit area remains low at about 2.1 tons per hectare.

The Africa-Korea Rice Laboratory, located in the AfricaRice Sahel Center in Senegal, is spearheading an effort to change this. The laboratory uses Korea's high-yielding Tongil type rice germplasm, but makes crosses with African resources to create a Tongil type rice population adapted to Africa. This is accomplished through double haploid rice breeding technology to produce excellent results in a short period of time. Through an elite line sharing system, the lab has so far provided 1,907 elite lines to 21 member countries—most recently, 200 elite lines during the course of 2023. Starting from the elite lines provided in this way, and progressing through national yield trials, 26 rice varieties have been released to farmers' fields in eight member countries and officially registered as new varieties (Table 3).

In addition, in order to enhance the breeding capacity of 21 member countries, the technical skills needed by breeders are provided through practice of the entire rice breeding and cultivation process, including sowing, fertilization, weed control, field management, artificial crossbreeding, selection, and harvest, during the whole rice growing period of 4 months. This training program has been developed continuously from 2017 to the present, during which 40 breeders from the 21 member countries have been successfully trained in eight batch training courses. The training has been evaluated as an excellent program and received useful support from member countries and trainees, and was restarted in the second phase of the project.

At the annual meeting held at the end of each year of the project, information is exchanged through breeding-related workshops and research results are shared and evaluated. These meetings further contribute to the ability of research directors from member countries and make researchers' activities more effective.

A new seed production course was begun in 2023 to provide seed production trainers with technical knowledge in production, management, and marketing for the distribution of new rice varieties. This course has a focus on member countries where new rice varieties have been registered or where registration is expected soon.

Another major initiative, the K-Rice Belt project, was created to distribute the varieties developed through the successful variety development results of AfricaRice and KAFACI. The Government of

Korea has also carried out international cooperation projects to alleviate food shortages in Africa by distributing 10,000 metric tons of seed per year in 10 African countries.

The great success of this broad effort has created a new sense of coordination and tight international bonds, being a win–win cooperation project based on mutual trust between AfricaRice, KAFACI, and all the member countries, which has only grown stronger through our projects with these countries over the past eight years. For their hard work and active cooperation toward achieving excellent results, AfricaRice thanks KAFACI and the national breeding scientists in all member countries: Burkina Faso, Comoros, Côte d'Ivoire, Democratic Republic of Congo, Ethiopia, Gabon, Gambia, Ghana, Kenya, Madagascar, Malawi, Mali, Morocco, Nigeria, Rwanda, Senegal, Sudan, Tanzania, Uganda, Zambia, and Zimbabwe.

Table 3. AfricaRice–KAFACI developed rice varieties between 2017 and 2023

Country	Variety	Ecology	Duration	Plant Height	Yield	Grain type	Blast reaction
Senegal	ISRIZ 6	Irrigated	103-120	85	7.2	Medium	
	ISRIZ 7	Irrigated	106-123	80	7.5	Medium	
	ISRIZ 16	Irrigated	102-115	88	9	Long grain	-
	ISRIZ 17	Irrigated	99-119	85	9	Long grain	Tolerant
	ISRIZ P01	Upland	80	96	2.5-4.5	Medium	Tolerant
	ISRIZ P02	Upland	111	79	3-5	Medium	Tolerant
Mali	KAFACI 1	Rainfed low land/ Irrigated	127	120	6-7	Medium	Tolerant
	KAFACI 2	Rainfed low land/Irrigated	134	100	5-6	Long grain	Tolerant
	KAFACI 3	Rainfed low land/ Irrigated	136	109	6-7	Long grain	Tolerant
Malawi	MAKAFACI	Irrigated/Rain fed	110	90	7.1	Extra long	
	WACHANGU	Irrigated/Rain fed	105	90	6.7	Long grain	
Zambia	ZAKAFACI 1	Rainfed low land/ Irrigated	141	71	7.3	Short	Tolerant
	ZAKAFACI 2	Rainfed low land/ Irrigated	136	77	6.8	Long	Tolerant
	ZAKAFACI 3	Rainfed low land/ Irrigated	140	71	8.5	Short	Tolerant
	ZAKAFACI 5	Rainfed low land/ Irrigated	140	71	7.8	Medium	Tolerant
	Sahel 134	Irrigated/low land	136	65	7.1	Medium	Tolerant
Rwanda	KATETA 21-1	Irrigated	140	100	7.3	Long grain	Mod. Sen
	KATETA 21-2	Irrigated	150	125	7.6	Medium	Tolerant
	KATETA 21-3	Irrigated	150	125	6.5	Medium	Tolerant
Tanzania	TARI-RIC3	Irrigated/ Rainfed low land	120-125	100	6.5-7.5	Long grain	Medium
Uganda	Ukafaci 39	Irrigation	100	96	7.2	Long grain	Tolerant
Ghana	CRI-Tuo Mo	Rainfed low land/Irrigated	125-130	110-120	6.9	Medium	Tolerant
	CRI-Kang Mc	Rainfed low land/Irrigated	120-125	110-120	6.3	Long grain	Tolerant
	CRI-korea Mc	Rainfed low land/Irrigated	120-130	110-120	7	Medium	Tolerant
	CRI-Baakoye	Rainfed low land/Irrigated	120-130	110-120	6	Long grain	Tolerant
	CRI-Agyapa	Rainfed low land/Irrigated	110-115	110-120	6.2	Long grain	Tolerant

Rice symposia, policy dialogues, and seed road map workshops catalyze investment in rice

The Gambia, Liberia, and Sierra Leone share rice as an important crop, and all three governments give it strategic priority for food and nutrition security as well as for the livelihoods of the countries' populations. Meeting their rice deficits puts huge pressure on these countries' economies and foreign currency reserves: rice imports cost The Gambia US$ 80 million, Liberia US$ 76.8 million, and Sierra Leone US$ 161 million a year.

Now, the consequences of the COVID-19 pandemic and the Russo-Ukrainian war on food and nutrition security have galvanized African governments to take action towards food sovereignty and import substitution. A major step has been the formulation and validation of phase II of the National Rice Development Strategies, with clear targets to reach rice self-sufficiency by 2030.

Within this context, the governments of The Gambia, Liberia, and Sierra Leone, in partnership with the African Development Bank-funded Technologies for African Agricultural Transformation phase II (TAAT II) and its AfricaRice-led Rice Compact, organized a series of rice symposia and policy dialogues as well as seed road map development workshops. The symposia and dialogues aimed to drive the rice transformation process in these countries by identifying crucial policies, exploring value-chain approaches, and showcasing opportunities through research, reforms, and investments in this strategic crop. The workshops aimed to support agricultural transformation through the establishment of sustainable and economically viable road maps that chart out seed classes, quantities, delivery, and scaling. The road maps also incorporate detailed aspects such as agro-chemicals, seed quality assurance and extension services.

The symposia, dialogues, and workshops brought together more than 300 participants per country from governmental institutions, multilateral and bilateral organizations, development institutions, local and international non-governmental organizations, the private sector, producers and processors, agricultural cooperatives, researchers, and agricultural professionals.

The immediate outcome of the rice symposium and policy dialogue in The Gambia was a presidential commitment to increase the productivity and production of quality rice towards an additional 150,000 metric tons per year, with support from the government, the private sector, and development partners to ensure best practices along the rice value chain. This will achieve 75% self-sufficiency by 2026.

In Liberia, as a result of the rice symposium and seed road map workshop, the Ministry of Agriculture has committed to operationalize a Seed Development and Certification Agency. Another immediate outcome has been firm support to the European Union-funded project Seeds4Liberia, led by AfricaRice. This project will produce 6,000 metric tons of certified rice seeds.

In Sierra Leone, a seven-year seed road map created out of the workshop has yielded a dividend by attracting Development Partners to provide funding support amounting to US$ 67 million for its implementation. This significant investment will be a first key step towards increasing production and productivity of rice in a country where per-capita rice consumption exceeds 100 kilograms a year.

The experiences from all three countries clearly demonstrate that the combination of rice symposia, policy dialogues, and seed road map development workshops can catalyze investment in rice value chains. It is thus important for the TAAT II Rice Compact to extend this to other countries—especially those where rice has been identified as an African Emergency Food Production Facility crop.

National Rice Forum and Policy Dialogue in The Gambia

Liberia Rice Symposium on Getting Rice Right

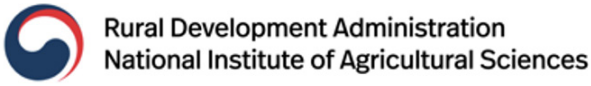
Sierra Leone Seed Roadmap for Rice, Cassava, Maize, and Soybean workshop

Partnership

Partnerships are the key to successful generation and scaling up of technologies and innovations since no single organization has the capacity to turn research into impact on its own.

This vision of partnership is at the center of AfricaRice operations. We collaborate with governments, local authorities, national agricultural research systems, regional and continental bodies, private sector, donors, technical partners, farmers associations, research institutions, rural communities… all those help us to contribute significantly to attain food and nutrition security and food sovereignty on the continent.

Our financial partners include but are not limited to:

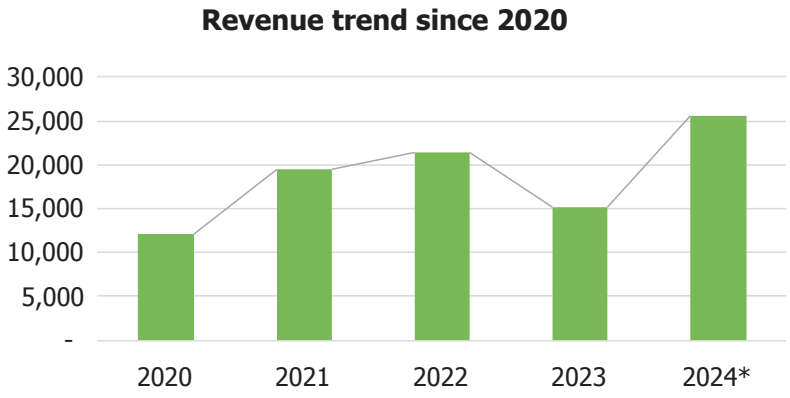


Finance overview

AfricaRice Financial situation continues to remain stable and gradually growing. The total operating revenues of the Center decreased from US$ 21.482 million in 2022 to US$ 15.175 million in 2023. The operating expenses also decreased from US$ 20.405 million in 2022 to US$ 14.830 million in 2023. This resulted in AfricaRice recording an operational surplus of US$ 0.345 million in 2023 against the operational surplus of US$ 1.077 million in 2022.

Other indicators of financial health

The short-term solvency (liquidity) indicator level of the Center increased to 160 days, from 102 days recorded in 2022, and the long-term financial stability ratio similarly increased to 121 days from 80 days as indicated for 2022. The audited indirect cost rate for AfricaRice increased to 16.1% during the year, from 15.2% in 2022. The current ratio increased from 1.38 in 2022 to 1.49 in 2023, which is within the CGIAR recommended level (greater than 1.0).



Funding Source	2022		2023	
	USD '000	%	USD '000	%
Initiatives	5,457	25.40%	6,779	44.64%
W3	4,259	19.82%	1,683	11.08%
Bilateral	10,839	50.45%	6,273	41.31%
Member Sates	659	3.07%	385	2.54%
Other	270	1.26%	67	0.44%
Total	21,484	100%	15,187	100%

Category of expenses	2022		2023	
	USD '000	%	USD '000	%
Research expenses	15,812	76.69%	11,740	78.98%
CGIAR Collaboration expenses	-	0.00%		0.00%
Non CGIAR Collaboration expenses	1,908	9.25%	1,035	6.96%
General and Administrative expenses	2,897	14.05%	2,090	14.06%
Total	20,617	100%	14,865	100%

Human resource overview

AfricaRice is committed to fair, safe, and inclusive workplaces. Our diversity powers our innovation. It's critical for our mission.

Total staff:
264

197
males

67
females

Hosted staff:
48

People trained:
9,831

4,327
males

5,504
females

AfricaRice Headquarter, Côte d'Ivoire
01 BP 4029, Abidjan, Côte d'Ivoire
Telephone: (225) 27 22 48 09 10
Fax: (225) 27 22 44 26 29
Email: AfricaRice@cgiar.org

AfricaRice M'bé Research Station
01 BP 2551, Bouaké, Côte d'Ivoire
Telephone: (225) 27 22 48 09 20
Fax: (225) 27 31 63 25 78
Email: AfricaRice@cgiar.org

AfricaRice Regional Station for the Sahel, Senegal
BP 96, Saint-Louis, Senegal
Telephone: (221) 33 962 64 41, 33 962 64 93
Fax: (221) 33 962 64 91
Email: AfricaRice-Sahel@cgiar.org

AfricaRice Nigeria Country Office
c/o IITA, PMB 5320, Ibadan, Oyo State, Nigeria
Telephone: (1) 201 6336094 and (234) 8034035281
Fax: (44) 20 87 11 37 86
Email: f.nwilene@cgiar.org

AfricaRice Madagascar Country Office
c/o FOFIFA, BP 1690 Antananarivo, Madagascar
Telephone: (261) 34 14 950 26
Email: g.mujawamariya@cgiar.org

AfricaRice Project Office, Liberia
c/o CARI Station, Suakoko, Bong County, Liberia
Telephone: (231) 880 946 266, 770 750 547
Email: i.akintayo@cgiar.org

AfricaRice Project Office, Uganda
c/o National Crops Resources Research Institute
PO Box 7084, Kampala, Uganda
Telephone: (256) 775 914 074
Email: e.twine@cgiar.org

© Copyright Africa Rice Center (AfricaRice) 2024
AfricaRice encourages fair use of this material. Proper citation is required. The designation used in the presentation of materials in this publication do not imply the expression of any opinion whatsoever by the Africa Rice Center (AfricaRice) concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers and boundaries.

Citation:
Africa Rice Center (AfricaRice). Africa Rice Center (AfricaRice) Annual Report 2023.Abidjan, Côte d'Ivoire: 46 pp.

ISBN:
Print 978-92-9113-420-5
PDF 978-92-9113-421-2

Photo credits:
All pictures are by staff members of AfricaRice, and networks and consortia convened by the Center.

Contact us
Head Office AfricaRice, 01 BP 4029, Boulevard François Mitterrand, Cocody, Abidjan 01, Côte d'Ivoire
T: +225 27 22 48 09 10; F: +225 27 22 44 26 29; E: AfricaRice@cgiar.org
M'bé Research Station, 01 B.P. 2551, Bouaké, Côte d'Ivoire
T: +225 27 22 48 09 20; F: +225 22 31 63 25 78
www.AfricaRice.org