

The IRRI logo consists of the letters "IRRI" in a white, serif font, centered within a solid green square. The background of the entire cover is a photograph of a young green rice seedling with a single blade of grass-like leaf, growing out of a cluster of dark, porous volcanic rocks. The background is a soft, out-of-focus grey.

IRRI

ANNUAL REPORT 2018

**BREAKING
NEW GROUND**



OUR MISSION

IRRI aims to improve livelihoods and nutrition, abolishing poverty, hunger, and malnutrition among those who depend on rice-based agri-food systems. In doing so, IRRI's work protects the health of rice farmers and consumers, and the environmental sustainability of rice farming in a world challenged by climate change. IRRI's work promotes the empowerment of women and supports opportunities for youth in an equitable agri-food system.

Our research for development is characterized by its collaborative nature: from alliances with advanced research institutes; through strong collaborations and capacity development with governments and national agricultural research and extension systems; to partnerships with the development sector and our ability to broker novel delivery channels through the private sector. IRRI's work is supported by a diverse network of investors aligned to common goals.

Goal 1

INNOVATION LEADERSHIP FOR THE GLOBAL RICE SECTOR

Be the linchpin of scientific innovation and thought leadership solving complex problems with deep research.

Working with advanced research institutes and national partners around the globe we will discover, translate, and integrate deep scientific advancements that enable the adoption of technologies, practices, and policies to solve complex global problems and serve our beneficiaries in rice-growing countries and beyond.

Goal 2

CATALYZE IMPACT AT SCALE FOR PEOPLE AND PLANET

Create and support catalytic networks driving widespread adoption of high-impact innovations and technologies.

Working across rice-growing countries in rural and urban communities, IRRI will speed up the translation of targeted innovations into the local rice value chain through partnerships, education, and technology to facilitate appropriate adoption, maximize impact in the shortest time, and produce substantive benefits for rice farmers, producers and consumers.

Goal 3

TRANSFORM RICE-BASED AGRI-FOOD SYSTEMS

Establish a track record of delivering successful policy interventions and institutional capacity building programs that underpin the development of equitable and sustainable rice sectors globally.

Capitalizing on its scientific and capacity building prominence and track record of delivery, IRRI will purposefully engage with global actors to inform policies and establish standards and benchmarks that transform how food is cultivated, produced, and marketed in rice-based agri-food systems.

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IRRI BY THE NUMBERS

- **USD69,508,000**
TOTAL REVENUE
- **132,442**
TOTAL VARIETIES IN
INTERNATIONAL GENE BANK
- **130**
ONGOING RESEARCH PROJECTS
- **20**
GENERAL AGREEMENTS SIGNED
- **370**
STUDENTS AND SCHOLARS THAT
RECEIVED EDUCATION AT IRRI
- **65,281**
FARMERS, RESEARCHERS,
AND EXTENSION AGENTS THAT
PARTICIPATED IN IRRI LEARNING
PROGRAMS
- **223**
PEER-REVIEWED PUBLICATIONS
- **252**
MEDIA ARTICLES ABOUT IRRI
- **9.1 MILLION**
ONLINE REACH FOR
INTERNATIONAL RICE
CONGRESS 2018

BREAKING NEW GROUND

In the first full year of implementation of IRRI's new strategic plan, we have begun to see the seeds of change take root and flourish. This year IRRI has broken new ground in research, stewardship of our most important genetic assets, and delivery of innovations in the countries and communities we serve.

IRRI's integrated research agenda has been strengthened this year through the infusion of new talent, new strategies, and additional financial investments. We have welcomed several new senior leaders to the organization in 2018. Arriving from complimentary international organizations, our sister CG centers, and the private sector, they bring with them a range of expertise and experience that will broaden IRRI's horizons and introduce new ideas and approaches. I am confident that these new points of view will propel IRRI's research agenda forward to address the increasingly complex challenge of creating an equitable and sustainable global rice sector.

A great example of new approaches to our Research-for-Development mission is the transition we saw this year from two of our flagship research programs to an integrated global strategy for rice breeding.

The Stress-Tolerant Rice for Africa and South Asia (STRASA) program delivered over half a million tons of climate-smart seeds to more than 18 million smallholder farmers over ten years. Today, these seeds are helping farmers secure their harvest in the face of abiotic stresses and environmental adversities. This investment has generated extensive national and regional networks across India, Bangladesh, Nepal, Tanzania, Uganda, Kenya, Mozambique, Burundi, Sierra Leone, Madagascar, and Mali, to name a few. These partner networks will be central to future efforts to develop varieties that outperform long-standing mega-varieties and meet farmer and market expectations.

By the same token, the Transforming Rice Breeding (TRB) investment enabled IRRI to continue its breeding modernization effort and we were delighted to assist partners such as the Bangladesh Rice Research Institute embark on their modernization journey.

The STRASA and TRB investments were made by the Bill & Melinda Gates Foundation and we are delighted that the foundation will continue to support the needs of smallholder farmers through the Accelerated Genetic Gain in Rice (AGGRi) Alliance program. This new integrated strategy will aim to create a unified, modernized, and globally-aligned NARES-IRRI breeding network. It will provide enhanced trait development and data-driven variety dissemination, market- and gender-responsive product profiles, and will monitor the rate of genetic gain delivered to farmers. We anticipate even greater benefits for farmers and their families through

this program. I would like to take this moment to express our gratitude to our STRASA and TRB partners. The gains from these investments would not have been possible without their unwavering support. We look forward to continuing our work together.

In 2018 IRRI also made great strides in enhancing our joint research agenda with the University of the Philippines in Los Baños (UPLB) in our host country of the Philippines. Over the course of the year we have worked closely with the academic leadership at UPLB to put several new research collaborations into place that will benefit the Philippine rice sector and Filipino academics. One example is the Improved Resource-Use Efficient rice varieties for the Philippines. The project will identify suitable introgression lines for high-yielding, weed-tolerant rice cultivars in order to develop

IRRI and its partners have risen to the challenge of change. In facing these challenges, the passion and dedication of our staff have helped the institute to meet its mission.

rice varieties that require less inputs of N-P-K fertilizers and irrigation water, which can help Filipino rice farmers reduce cost outlay while maintaining yields.

As a research institute, I am also proud to report that IRRI's impact factor has been steadily rising over the past five years. In 2018, IRRI scientists published over 223 peer-reviewed articles, with nearly half of them immediately available for public access. Most notably, the practical implication of this research means that information from the sequencing of 3,000 rice germplasm accessions is now being used to develop healthier rice varieties and to discover a potential new genetic weapon against bacterial blight, a rice disease that robs millions of farmers—and their families—of their livelihood each year.

In our strategic plan, IRRI renewed its commitment to steward our genetic resources and establish new opportunities for future generations to access the extraordinary genetic resources contained in our genebank. This is why we were particularly pleased to sign a landmark agreement with the Global Crop Diversity Trust that will guarantee perpetual funding of the International Rice Genebank.

As the first CG Center to achieve the qualifying standard and receive this funding, the agreement comes at a time when a safe and secure repository of rice biodiversity is more urgent than ever. As challenges arise from climate change, urbanization, environmental degradation, and a growing global population, the International Rice Genebank provides

plant breeders with the biodiversity they need to develop robust crop varieties that are highly productive and resilient for farmers and provide urban consumers with improved nutritional values.

This year we have also accelerated the pace of engagement with partners across the spectrum, including the private sector. Over the last year, we signed several new agreements for shared access to germplasm collections as well as precision breeding technologies. The goal is to expand our joint capacity to develop new rice varieties that deliver higher yields and better resilience to biotic and abiotic stresses. These agreements demonstrate IRRI's commitment to harnessing the best agricultural innovations to build a sustainable and equitable global rice sector.

We believe that IRRI's greatest impact can be felt in the regions where we work. Over the past year we have been actively pursuing our regionalization strategy; strengthening our capacity for partnerships and delivery in locations where it is needed most. IRRI broke new ground in 2018 with the establishment of two new centers—the IRRI Regional Office for Africa in Nairobi, Kenya and the IRRI South Asian Research Centre in Varanasi, India. These centres will be catalysts for South-South collaboration, enhancing the research expertise and capacity of rice-growing countries in their regions.

Late in 2018, IRRI held the much anticipated 5th International Rice Congress in Singapore. The Congress is a unique global platform for current scientific endeavors and exciting disruptive technologies in agriculture such as robotics, nanotechnology, 3D printing, and gene editing. The Congress also featured keynote addresses from global authorities such as Gilbert Hongbou, president of the International Fund for Agricultural Development, and Dr. Kundhavi Kadiresan, assistant director general of the Food and Agriculture Organization of the United Nations.

In closing, I reflect on the idea that change, by its very nature, is often uncomfortable and challenges us to think differently about the world around us. Change can also bring great rewards. As we've seen through the achievements and activities listed in these pages, IRRI and its partners have risen to the challenge of change. In facing these challenges, the passion and dedication of our staff have helped the institute to meet its mission. I'd like to take a moment to thank our staff, our Board of Trustees, our partners, and our investors for coming along with us on this journey, and for their support and trust in our vision.

I am confident that 2019 will prove to be another rewarding year. Our vibrant research agenda and extensive partnership network will help IRRI develop and translate innovations for those who need them most. I am deeply excited about the potential that our research and our partnerships have for solving key challenges in the rice sector and look forward to seeing the work of IRRI and its partners translate into further significant improvements in the lives of rice farmers and consumers across the world.


Matthew Morell
Director General



Delivering on the Global SDGs through 9 Outcome Themes



Nine research objectives that map the impact pathways of our research



FACILITATING RICE RESEARCH THROUGH ENABLING TECHNOLOGIES

Research areas

- Genome sequencing and high-throughput genotyping
- Novel phenotyping and breeding informatics
- Partnerships and technology transfer in research-driven innovation

HOW IRRI'S RESEARCH IS CREATING AND ACCELERATING IMPACT FOR PEOPLE WHO DEPEND ON RICE-BASED AGRI-FOOD SYSTEMS



IMPROVING HEALTH THROUGH SAFE AND NUTRITIONALLY ENHANCED RICE

Research areas

- Biofortification of rice with micronutrients
- Low-glycemic index rice
- Heavy metal contamination



DEVELOPING ENVIRONMENTALLY SUSTAINABLE SOLUTIONS FOR RICE SYSTEMS

Research areas

- Mitigating and adapting to climate change
- Sustainable water management
- Reducing energy footprints
- Improving soil health
- Preserving biodiversity and understanding pest ecology



BUILDING RESILIENCE OF RICE-BASED SYSTEMS IN MARGINAL ENVIRONMENTS

Research areas

- Develop climate-resilient rice varieties
- Spearhead innovation on rice abiotic and biotic stress tolerance and adoption
- Develop production system technologies and knowledge for marginal environments



SHAPING FUTURE RICE VALUE CHAINS AND POLICIES

Research areas

- Facilitate and convene partnerships of rice stakeholders
- Develop policies and strategies for rice agri-food systems
- Monitoring and evaluation, impact assessment, market analysis
- Guide future-focused research, development, and policy investments



HARNESSING RICE GENETIC DIVERSITY TO ACCELERATE IMPACT

Research areas

- Preserve rice biodiversity from all over the world
- Efficient cataloguing of over 132,000 rice genetic resources
- Provide breeders with rice germplasm for research



INTEGRATING BREEDING AND CROP MANAGEMENT SOLUTIONS FOR INTENSIVE SYSTEMS

Research areas

- Breeding programs for high-yielding rice varieties
- Rice breeding systems and networks
- Crop management best practices and tools
- Seed systems, mechanization, postharvest



CATALYZING INNOVATION FOR HEALTH, EQUITY, AND RESILIENCE

Research areas

- Capacity building and education, particularly for women and youth
- Training for seed selection and entrepreneurship
- Crop and diet diversification for nutrition



ENABLING DATA-DRIVEN DECISION SUPPORT FOR RICE AGRI-FOOD SYSTEMS

Research areas

- Applied information technology
- Geographic Information Systems (GIS)
- Decision support tools and apps
- Site-specific agronomic management

3000 RICE GENOME PROJECT ADVANCES DEVELOPMENT OF LOW GI RICE TO ADDRESS GROWING DIABETES EPIDEMIC

A recently published study, which integrated a genome-wide association study with a large-scale transcriptome analysis, is helping predict genetic regions in rice that influence its glycaemic index (GI) and texture.

Drawing on the genomic information amassed during the sequencing of 3,000 rice germplasm accessions, the aim is to identify novel sources of germplasm that could be used to identify and develop low-GI rice varieties that are a healthier option for people who have, or are at risk of, diabetes.

The number of people living with diabetes has almost quadrupled since 1980, reaching up to 422 million adults, with most living in developing countries, according to a 2016 report by the World Health Organization. White rice ranks high on the food GI making it one of the starchy foods that could contribute to the risk for diabetes when eaten in excess with an inactive lifestyle. But different types of rice have different GIs, ranging from a low of 52 to a high of 100. By choosing the right variety, rice can be part of a healthy, low-GI diet for people who have diabetes or are at risk of developing it, an important step towards diet-based intervention.

For plant breeders, the challenge is altering the starch structure of rice to lower its digestibility so that it provides a slow and steady supply of energy but without sacrificing its cooking and eating quality. A low-GI rice variety with hard texture is



undesirable in South East Asian market niches, where soft and sticky types are the benchmarks of rice quality.

This research on low-GI rice, funded by the CGIAR Research Program on Rice and published in December 2018 in the *Plant Biotechnology Journal*, explores the potential of big data-based crop research for rapidly sifting through the rich rice gene pool and identifying genes for developing rice varieties with low GI but with good eating and cooking qualities preferred by health-conscious consumers—within years rather than decades. IRRI plans to take this innovation further to mainstream the lowering of GI without compromising texture as a priority breeding target.

The 3000 Rice Genome Project is a collaboration between IRRI, BGI Shenzhen, and the Chinese Academy of Agricultural Sciences. The entire dataset is publicly available on GigaScience's open-access database, GigaDB. The sequencing and initial analysis was funded by grants from the Bill & Melinda Gates Foundation and the Chinese Ministry of Science and Technology.

Further reading: Anacleto R, Badoni S, Parween S, Butardo, VM Jr, Misra G, Cuevas RP, Kuhlmann M, Trinidad TP, Mallillin AC, Acuin C, Bird AR, Morell MK, Sreenivasulu N. Integrating a genome-wide association study with a large-scale transcriptome analysis to predict genetic regions influencing the glycaemic index and texture in rice. *Plant Biotechnology Journal* 2019 doi: 10.1111/pbi.13051.

THE WORLD'S RICE BOWL: PROTECTED IN PERPETUITY

The world's largest rice germplasm collection received permanent funding for the conservation and sharing of over 132,442 varieties of the staple crop that feeds more than three billion people worldwide. The agreement between IRRI and the Crop Trust guarantees funding for the International Rice Genebank worth USD 1.4 million a year in perpetuity.

"This is a landmark moment for IRRI and for Crop Trust," said Marie Haga, executive director of Crop Trust. "At a time when many donors have increasingly complex demands on their resources, it is important that the world's crop collections are safe, secure, and the genebanks are functioning effectively."

Scientists at IRRI have used the rice samples stored in the bank to develop rice breakthroughs tailored to climate extremes like drought and flooding which are already threatening production in key rice-producing countries, including India, China, the Philippines, Vietnam, Myanmar, Cambodia, Indonesia, and Malaysia.

The annual funding will be sourced from the Crop Trust's endowment fund, which was established in 2004 to provide sustainable, long-term financial support to the world's most important food and agriculture genebanks.

The first phase of the funding will cover essential operations of the International Rice Genebank from



2019-2023, including conservation, regeneration, and distribution of its cultivated and wild seed collections. As part of the long-term partnership, IRRI will also provide expert advice to five national genebanks to help their crop conservation efforts. The agreement is envisaged to continue after 2023 with a second five-year phase allowing for any revisions in the business plan and operational costs of the International Rice Genebank and will be renewed every five years into the future.





GATES FOUNDATION FUNDS USD 30M IRRI INITIATIVE TO UNIFY AND MODERNIZE RICE BREEDING EFFORTS IN SOUTH ASIA AND AFRICA

IRRI deepened its partnership with the Bill & Melinda Gates Foundation (BMGF) in a ground-breaking initiative to help hundreds of thousands of smallholder farmers in the developing world grow better rice crops and improve their livelihoods.

The Accelerated Genetic Gain in Rice (AGGRi) Alliance will unify and modernize existing rice breeding efforts in South Asia and Sub-Saharan Africa. The USD 30 million five-year research program, funded by BMGF, will sustainably provide new and improved rice varieties to farmers. In particular, it will focus on the needs of women in the rice value chain.

The AGGRi Alliance will combine the progress made in modernizing IRRI's rice breeding through the recently-ended Transforming Rice Breeding (TRB) project with

the trialing networks and germplasm from the Stress Tolerant Rice for Africa and South Asia (STRASA) project into a single initiative that will expand rice variety testing networks into a globally aligned, modernized rice breeding "community of practice."

These regional networks will be unified by a set of standards developed to make breeding decisions consistent with the demands of farmers, consumers, and processors in those regions. The overall objective will be to create high-performing national agricultural research and extension systems breeding networks across Africa and South Asia, linked to the centralized breeding capacity at IRRI.

TRB and STRASA were also funded by BMGF.

HOW INDIA IS ADVANCING SOUTH-SOUTH COLLABORATION IN SOUTH ASIA AND AFRICA

Prime Minister of India Shri Narendra Modi furthered his vision of doubling farmers' incomes with the inauguration of the IRRI South Asia Regional Centre (IRRI SARC) in Varanasi, Uttar Pradesh.

Inaugurated by the Prime Minister on December 29, 2018, the research facility will strengthen the national research capacity of rice-growing countries in South Asia and sub-Saharan Africa. Delivering advanced research, education and services to improve crop production, grain quality and the nutritional value of rice, IRRI SARC will also work with national partners to enhance farmers' knowledge and income.

"This is a landmark moment for India and IRRI," said IRRI Director General Matthew Morell. "This state-of-the-art rice research center will catalyze South-South collaboration, strengthen the research expertise and capacity of rice-growing countries in the region, and contribute to the UN Sustainable Development Goals. It is only through the support of our network of global partners, such as the Government of India, that knowledge and innovations gained at this facility can be speedily tailored to meet needs of farmers in India, across South Asia, and across Africa."





IRC NUMBERS

- 1341** delegates
- 65** countries
- 35%** students
- 23%** senior leaders
- 9** plenary speakers
- 2** panel discussions
- 18** exhibits
- 29** side events
- 300** posters
- 9.1M** online reach



Young entrepreneurs Vannie Koay, Lincoln Lee, Loh Rachel, and Kisum Chan of the IIRI-supported social enterprise and 2018 Hult Prize winner Rice Inc., attended the congress as special guests.

THE FUTURE OF RICE IS THE FUTURE OF BILLIONS OF PEOPLE: INTERNATIONAL RICE CONGRESS CONVENES KEY PLAYERS IN THE GLOBAL RICE SECTOR

Held on 15-17 October in Singapore, the 5th International Rice Congress (IRC2018) was the biggest gathering of thought leaders, scientists, policymakers, agriculture experts, and technology providers from the world of rice research and production.

Rice is the world's most important food crop, providing sustenance and nutrition for billions of people, as well as income and livelihood for hundreds of millions of farming families. Burgeoning factors such as climate change, rising populations, urbanization, and competition for natural resources are making it more and more difficult to keep up with ever-increasing global demand, creating a significant challenge for food security.

Organized by the IIRI, IRC2018 brought together over 1,300 delegates from 65 countries to meet, share, and learn about the latest research and innovations, cutting-edge technologies, and ideas and policies shaping the future of this critical food staple.

IRC featured major events designed to stimulate the exchange of ideas, partnerships, and the exploration of new innovations. IRC hosted the 30th International Rice Research Conference, the 8th Rice Genetics Symposium, as well as various plenaries from thought leaders, high-level panel discussions, dozens of side events and exhibits, and over 300 scientific posters from contributors.

FAO Assistant Director General Dr. Kundhavi Kadiresan, Singapore Minister of National Development Lawrence Wong, IIRI Director General Matthew Morell, and IFAD President Gilbert Houngbo renewed their respective commitment to achieve Zero Hunger by 2030.



IRRI Chief of Staff Peter Brothers presents an Outstanding Alumni Award to Dr. Muhamad Abdul Hamid Miah from Bangladesh. Seven scientists from around the world were presented awards during IRC, which include the Young Scientist Award and the Senadhira Rice Research Award.



Exceptional rice scientists from all over the world were recognized with the awarding of the Young Scientist Award, the Senadhira Rice Research Award, and the Outstanding IIRI Alumni Award.



IFAD President Gilbert Houngbo in his keynote stressed that to eliminate hunger and poverty, there must be inclusive and sustainable investment in rural transformation.



Dr. Qifa Zhang shared how genomic research in China is advancing Green Super Rice development to create more productive, sustainable, and environment-friendly rice systems.



Oxfam global agricultural adviser Le Nguyet Minh discussed how developing sustainable rice systems must be inclusive of women, who comprise the majority of smallholder farmers.



Amazon VP and CTO Werner Vogels shared how cloud computing and blockchain technology can help rice scientists and farmers.

IRRI JOINS OTHER CGIAR CENTERS TO HELP AFRICA ACHIEVE 90% RICE SELF-SUFFICIENCY BY 2025

IRRI opened a new regional office in Nairobi, Kenya to help Africa boost its rice productivity and self-sufficiency. Hosted by the International Livestock Research Institute and working closely with the Africa Rice Center (AfricaRice), the new regional hub will speed up IRRI's ability to translate its 60-year history of success transforming the Asian rice sector to the African context.

IRRI's efforts in the region will complement national agriculture priorities and a continent-wide strategy. The plan aims to reduce reliance on rice imports and reach 90% rice self-sufficiency by 2025. IRRI initiatives that support these priorities include deployment of high-yielding and climate-smart rice varieties, dissemination of locally adapted best practices in crop management and intensive farming, building the capability of rice scientists, and fostering partnerships that work towards efficient, sustainable and profitable rice-based systems.

"We are very excited to intensify our engagement here in Africa," said IRRI Director General Matthew



Morell. "Africa's rice sector has enormous potential for growth. With strong leadership from governments and institutions, Africa can be self-sufficient in rice production and become a top producer globally, contributing to worldwide food security. IRRI's research-based solutions for the rice sector coupled with the work of our sister CGIAR centers, national partners, and the private sector can help deliver these results."



INNOVATE

BE THE LINCHPIN OF SCIENTIFIC INNOVATION AND THOUGHT LEADERSHIP SOLVING COMPLEX PROBLEMS WITH DEEP RESEARCH

As it works toward building a smarter and sustainable rice sector, IRRI draws on the strength of its innovation edge for new ideas that will address upcoming challenges in crop production and productivity. In 2018, IRRI partnered with government and private organizations in its relentless pursuit of innovations that benefit farmers and push the limits of rice science into new disruptive territories. These are some of the groundbreaking explorations centered on bringing the newest technology into the farmer's field.





CONNECTING RICE FARMERS WITH SEED PRODUCERS IN ODISHA

IRRI, together with the Odisha Department of Agriculture and the Odisha State Seed Corporation, is connecting global innovative solutions to local needs through a mobile application and web-based Management Information System portal.

SeedCast, the mobile app, estimates seed demand by farmers in the state and will help streamline the demand and supply of seeds for different varieties of rice. The app is seen as a solution for seed corporations that have been grappling with the issue of estimating demand for seeds at the start of the kharif season.

“*SeedCast* will make the seeds supply chain robust by helping dealers indicate their demand through a formal platform,” said Dr. Manzoor Dar, IRRI cluster leader for Seed and Delivery Systems and Germplasm Evaluation. “The data generated by the app can be viewed and analyzed which will help state functionaries and the state seed corporation plan accurately for seasonal seed production and procurement, and facilitate better seed availability according to demand.”

DISCOVERING NEW WAYS TO CONTROL A MAJOR RICE DISEASE

Bacterial blight is a major rice disease that severely affects rice production in Asia. In irrigated environments, bacterial blight can easily spread to large areas causing up to 30% in losses and a huge impact on the income of smallholder farmers.

Major genes called *Xa* genes (e.g., *Xa4*, *Xa5*, *Xa21*), have already been used in rice breeding programs for developing varieties that have some resistance to the disease. However, despite the importance of these genes in controlling the disease, the bacterium adapted to these resistant varieties making them susceptible again. There is a need to continue discovering new ways and developing varieties that can protect farmers from losses caused by bacterial blight.

In a recent paper published in *PLOS One*, scientists discovered variations of the *SWEET* (sugars will eventually be exported transporter) genes that give plants resistance to *Xanthomonas oryzae* pv. *Oryzae*, the organism that causes bacterial blight.



Under normal conditions, the pathogen promotes the leakage of sugars by activating the *SWEET* genes inside the plant cell. However, the new *SWEET* gene variants prevent the release of sugar and the bacterium fails to get nutrition from the host plant and it eventually dies. The gene naturally occurs in rice and offers a promising strategy to gain resistance against bacterial blight.

“Using IRRI’s rich germplasm collection, we were able to discover the potential of variations in the *SWEET* gene to be used in breeding new blight-resistant varieties,” said Dr. Ricardo Oliva, a plant pathologist at the institute. “The variations appear to have emerged from at least three rice subspecies. This opens up the gates to use similar techniques to fight other pathogens in rice as well as in other crops such as corn, wheat, and cassava.”

At present, the *SWEET* gene variants have been introduced into IRRI’s breeding pipeline and a new class of rice varieties resistant to bacterial blight will be available in a few years.

UNLOCKING RICE GENE DIVERSITY FOR FOOD SECURITY



A new study published in *Nature* opens the possibility of accelerating rice breeding to achieve food security for some of the world's most vulnerable rice farmers.

Genomic variation in 3,010 diverse accessions of Asian cultivated rice maps the largest set of genomic variants for a crop species. This recent research revealed that there are significant variations in gene content and immense sequence variation among the 3,000 rice genomes. Researchers identified more than 10,000 new rice genes and over 29 million simple variations throughout the genome. Additionally, within the two major rice variety groups, the analysis revealed the existence of previously unreported populations that are unique to specific geographic origins.

A collaboration among IRRI, CAAS, BGI-Shenzhen, and 13 other partner institutions, the research will enable scientists to discover new gene variants and characterize known genes for important traits such as the natural ability of a particular variety to resist diseases and withstand floods, drought, and saline water. Additionally, molecular breeders could use the genetic markers to select rice plants that are more likely to carry the desired trait before they are planted in the field.



ROLLING OUT NEW HYBRID RICE LINES FOR FUTURE HIGH-PERFORMING VARIETIES

"This year, we were able to develop new populations and parental lines for breeding, new hybrids for testing, and new DNA markers for forward breeding," Jauhar Ali, coordinator of the Hybrid Rice Development Consortium (HRDC), reported at the 2018 HRDC annual meeting. "These advances generated more resources and opportunities that enabled HRDC members to develop high-performing varieties."

Dr. Ali also reported the licensing of two hybrid rice varieties (Mestiso 61 and Mestiso 68) to SL Agritech Corporation under the limited exclusivity agreement. Mestiso 30, another new hybrid rice variety was provided to Advanta Seeds under a non-exclusivity license agreement.

Collaborations between IRRI and private partners in hybrid rice research and development significantly accelerate and broaden the distribution and delivery of improved seeds to farmers globally. "These agreements are expected to generate benefits not just for HRDC but, more importantly, for the smallholder farmers who will use the developed hybrid rice varieties," said Dr. Ali.

One of the highlights of the two-day meeting is a series of discussions led by IRRI scientists on using bacterial genomics for effective pathogen monitoring in rice, the potential of direct-seeded rice hybrids in maximizing productivity and environmental sustainability in Asia, and the impacts of hybrid rice in the yield and income of smallholder farmers.

PARTNERSHIPS ADVANCING RICE SCIENCE IN INNOVATIVE WAYS



USING AI TO DEVELOP MILLIONS OF POTENTIAL NEW RICE VARIETIES

IRRI teamed up with Germany-based biotechnology company Computomics GmbH to use the latest bioinformatics tools to mine the big data available at the institute. IRRI's 60 years of expertise and rice breeding information will be harnessed by Computomics' artificial intelligence (AI) systems using powerful algorithms to process and analyze billions of phenotypic, genotypic, grain quality, progeny, and environmental data. The goal is to speed up rice breeding efforts and score millions of potential new rice crosses and varieties with higher yields, better nutritional content, or stronger resilience to climate change.

COLLABORATING ON NOVEL APPROACHES TO PROTECT RICE CROPS FROM DEVASTATING DISEASES

IRRI entered a 4-year agreement with Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) to collaborate on transgenic research for functional diversity in rice to develop novel strategies for resistance to diseases such as rice blast. The restricted-use agreement will allow IRRI and CSIRO to share research and expertise, and allow each other usage of proprietary IP for use in the collaborative program. Aside from disease resistance, other projects covered in the agreement include promoting higher stability and nutritional value in bran oil, increasing leaf oil production, and development of a rice protoplast system.

EXPANDING GLOBAL RICE BREEDING WITH DNA MARKER TECHNOLOGY

IRRI entered into a partnership with Intertek, a Total Quality Assurance provider, for the broader distribution and active use of IRRI's DNA markers for marker-assisted rice breeding programs in the public and private sectors. The same DNA markers can be used for quality control along the rice value chain. Through this agreement, Intertek will provide a volume of sample analysis to the institute to contribute to IRRI's breeding programs.

BREEDING MORE SUPER-EFFICIENT RICE VARIETIES FOR A GREENER AGRICULTURE

A funding and research collaboration between IRRI, the CAAS, and BMGF will focus on developing Green Super Rice. Green Super Rice is a mix of more than 250 different potential rice varieties that can adapt to difficult growing conditions such as drought and flood. The lines also use less fertilizer and no pesticides, which reduces the need for herbicides. At present, more than 130 advanced breeding lines with these traits are undergoing national varietal testing and will soon be released in different countries as new varieties. Forty-two Green Super Rice varieties have been developed and have been made available in 11 countries in South Asia, Southeast Asia, and East and South Africa as of 2017, covering more than 1.7 million hectares of farmland. Eighteen of these varieties were bred at IRRI.



CATALYZE

CREATE AND SUPPORT CATALYTIC NETWORKS DRIVING WIDESPREAD ADOPTION OF HIGH-IMPACT INNOVATIONS AND TECHNOLOGIES

Integrating new techniques and technologies into traditional rice value chains can be slow and difficult to achieve. Agricultural practices and needs in different areas can vary greatly depending on a multitude of factors. IRRI and its partners are investing resources into localized, impact-driven initiatives to promote innovation, build up capacity, and support the development of governments, farmers, and stakeholders in rice-growing regions around the world.



EDUCATING INDIAN WOMEN FARMERS TO BE TECHNOLOGY INFLUENCERS



Eight participants from women self-help groups, women organizations, and producer companies attended training on advanced rice production to prepare them for their critical role as agents of change.

“The training program which we have developed is designed for women farmers all over India,” said Poornima Ravi Shankar, coordinator of the program. “It is being rolled out in different phases which exposes the participants to both locally appropriate solutions and best management practices from different parts of the world.”

The first phase of the program, an eight-day basic rice production course, was held in Bhubaneswar, Odisha. The course, implemented by IRRI Education, featured new rice technologies and basic best management practices to boost rice production efficiency at the grassroots level. The participants will take these latest technological innovations and teach other women farmers. The implementation of these plans will be monitored by the Department of Biotechnology.

More long-term capacity-development programs for women farmer leaders are in the pipeline to jumpstart agricultural transformation and improve livelihoods through innovations in cropping system technologies.



BRINGING INTENSIVE FARMING TECHNOLOGIES CLOSER TO NEPAL'S RICE FARMERS

Nepal has been IRRI's partner in many initiatives that aim to transform the rice sector in Asia. However, most Nepalese farmers still practice traditional bullock-drawn and manual farming. These old mechanisms require more time and manual labor, but do not bring in much profit.

On a recent trip to Nepal, IRRI Director General Matthew Morell, along with rice scientists, extension professionals, and local governments, held a dialogue with smallholder farmers and project partners. Dr. Morell reviewed the progress of IRRI's projects with national agricultural research and extension systems. A number of trials on climate-resilient rice varieties, mechanized direct seeded rice (DSR), and other activities have been set up in areas where a World Bank-funded irrigation infrastructure project is currently under construction.

He also visited spring rice fields where rice harvesting of the IRRI-developed climate-resilient variety Hardinath-3 was in progress. Intensification of spring rice is key to significantly improving rice production in Nepal.

“Mechanized DSR using best management practices and mechanized harvesting are key to reducing the cropping cycle by about two weeks and improving overall productivity and grain quality,” said Krishna Dev Joshi, IRRI country representative in Nepal. “It is important to customize these technologies and improve our capacity at all levels to be able to fully benefit from these rice science innovations”.

By expanding the availability of technologies and best practices for the rice agri-food system in the country, Nepalese farmers will be able to increase productivity and incomes—a goal that the World Bank, IRRI, and the Nepal Government are keen on achieving together through an innovative partnership.



TAPPING CAMBODIAN FARMERS FOR AN IMPORTANT ROLE IN RICE BREEDING

IRRI is engaging with Cambodian farmers to help transform rice breeding to be more efficient and market-oriented. Together with the Cambodian Agricultural Research and Development Institute and the General Directorate of Agriculture, IRRI conducted behavioral experiments with Cambodian rice farmers in Prey Veng and Takeo to learn their preferences that will guide breeders in future rice varietal improvements.

The participating farmers were trained in digital product profiling through an interactive app called *Investment Game Application*. The app enables them to participate in a simulated investment market for public rice breeding. This helps researchers in setting priorities and make breeding programs more cost-efficient, market-driven, client- and product-oriented, and forward-looking.

The study is being financed by the German Federal Ministry for Economic Cooperation and Development, under the Leveraging Diversity for Ecologically Based Pest Management project, and the CGIAR Research Program on rice agri-food systems.

SPREADING CLIMATE-SMART RICE PRODUCTION TECHNOLOGIES IN BANGLADESH



The Northwest Focal Area Network (FAN) in Bangladesh is a network of hundreds of farmers, well owners, researchers, and extension agents that focuses on rice-based systems. The network was recognized for the dissemination of climate-smart technologies like alternate wetting and drying (AWD), an irrigation system that floods and dries the field in turn, which saves water and reduces greenhouse gas emissions.

This practice was introduced to over 5,000 rice farmers across 8 districts and 17 locations in Rangpur, with testing and practicing of the AWD technology underway, along with other mitigation measures.

The FAN initiative took form through the Mitigation Options to Reduce Methane Emissions in Paddy Rice, a project currently implemented by IRRI in Bangladesh and Vietnam. It is supported by the Climate and Clean Air Coalition (CCAC) and the CGIAR Research Program on Climate Change, Agriculture, and Food Security.

“We are mobilizing the water users and suppliers, farmer groups, and extension people to practice the AWD system across 2 million hectares of rice area,” said Mamunur Rashid, Rangpur Dinajpur Rural Service (RDRS) agriculture coordinator. RDRS oversees the program and activities of FAN as the network secretariat. “We aim to reduce methane emissions by more than 50% and irrigation water by 30% in 17 locations in the northern areas. This aligns with our government’s mission and global commitment to reduce greenhouse gas emissions.”

For its effort, FAN-Bangladesh received the Innovation in Behavioural Change Award from the CCAC during the 2018 Global Climate Summit.

WORKING TO ACCELERATE IMPACT ACROSS THE RICE- GROWING WORLD



IDENTIFYING WHAT VIETNAMESE RICE CONSUMERS WANT

As one of the world's leading producers and exporters of rice, there is a pressing need for Vietnam to promote sustainable rice farming. A recent study by researchers from IRRI, Hue University, and Ghent University tested urban Vietnamese consumers' response to sustainable production labels in rice.

Published in *Food Policy*, a leading international journal in agricultural economics, the behavioral market study revealed that consumers are willing to pay for rice produced and labeled under the national sustainable production standard "VietGAP."

The researchers also found that consumers were willing to pay price premiums of 9% for certified sustainably produced rice on top of the price of regular rice. These premiums even further increased up to 33% when they were informed about what the label on sustainably-produced products mean and where exactly the rice was produced. Consumers that consider themselves as environment- and health-conscious tended to be most responsive to sustainable production labels.

"The Mekong River Delta is facing severe environmental challenges due to overuse of agrichemicals in rice production," said Dr. Matty Demont, an economist at IRRI. "Recent food safety concerns may have fueled Vietnamese consumers' demand for certification of sustainable production practices in agriculture."

MODERNIZING RICE BREEDING PROGRAMS AROUND THE WORLD

IRRI, the Excellence in Breeding Platform, and the Genomic Open-Source Breeding Informatics Initiative gathered experts from advanced research institutes around the globe to advance breeding innovations and solve increasingly complex problems in rice-growing countries.

Forty participants from public sector breeding programs across ten countries attended the Joint Breeders' Training and Workshop to discuss, evaluate, and enable agricultural institutions in Asia and some parts of Africa to modernize their breeding programs. IRRI Integrated Research Support, Intertek from Sweden, and Diversity Arrays Technology in Australia also participated, offering access to cutting-edge research technologies and services.

USHERING IN AGRIBUSINESS AND RURAL TRANSFORMATION IN ASSAM

The World Bank and the State Government of Assam launched the Assam Agribusiness and Rural Transformation project, a 7-year program that aims to add value and improve the resilience of agriculture value chains in the Indian state. It focuses on improving the food and livelihood security of smallholder farmers and agro-entrepreneurs by increasing their access to updated knowledge and technologies.

IRRI is tasked with providing technical guidance on improving rice production systems and management practices by promoting climate-resilient technologies, encouraging their adoption on-field, and facilitating market linkages.



TRANSFORM

ENGAGE WITH GLOBAL ACTORS TO INFORM POLICIES AND ESTABLISH STANDARDS AND BENCHMARKS THAT TRANSFORM HOW FOOD IS CULTIVATED, PRODUCED, AND MARKETED IN RICE-BASED AGRI-FOOD SYSTEMS

Technological and scientific discoveries are providing new ways to better understand the impact of growing food and changing the way the world produces rice. IRRI combines its world-leading expertise in rice research with the distinctive strengths of its partners to make the discoveries that help improve the well-being of subsistence farmers while protecting the environment. In 2018, the institute's innovative partnerships and collaborations have created new scenarios for a cleaner, healthier, and flourishing rice sector that serves as the cornerstone for ending poverty and hunger.





CREATING A DEEP AND LASTING IMPACT ON SOUTH ASIA AND AFRICA'S RICE PRODUCTIVITY

Stress-Tolerant Rice for Africa and South Asia (STRASA) is a 10-year project established by IRRI and AfricaRice in 2008. Its goal is to reduce poverty of at least 18 million farmers and stabilize rice production in drought- and flood-plagued and poor-soiled rainfed ecosystems in South Asia and Africa through the use of modern technology. In 2018, about 160 delegates from South Asia, Africa, Philippines, and the USA convened for the project's 11th annual meeting to assess its successes, challenges, and milestones and set directions until its completion at the end of March 2019.

In its first three-year phase, major progress was made on developing improved germplasm, developing participatory evaluation networks, seed production and release of stress-tolerant varieties, targeting of stress-tolerant varieties for large-scale delivery, impact analysis, and strengthening capacity. In Phase 2, seed and information dissemination was considerably scaled up while breeding work focused on taking advantage of the progress made in identifying genes conferring tolerance for the major environmental stresses.

To date, STRASA, which is funded by BMGF, produced about 230,000 tons of seeds and distributed these to nearly 8 million farmers in India, Nepal, and Bangladesh. STRASA also disseminated more than 200 rice varieties in over 18 countries in sub-Saharan Africa.

"We consider STRASA to be the most successful project in recent times, paving the way for a second Green Revolution in Eastern India," said Dr. S. K. Pattanayak, secretary of the Department of Agriculture, Cooperation, and Farmers Welfare of India. "The country is going to reach 111 million tons of rice this year, and for this, credit should go to this project."

MEETING GLOBAL FOOD SAFETY STANDARDS



Golden Rice, a provitamin-A biofortified rice variety, completed its third positive food safety evaluation from the United States Food and Drug Administration (US FDA). The US FDA statement comes on the heels of the safety and nutrition approvals from Food Standards Australia New Zealand, and Health Canada making Golden Rice the first nutritionally enhanced genetically modified rice to receive regulatory approval for use in food.

"Each regulatory application that Golden Rice completes with national regulatory agencies takes us one step closer to bringing Golden Rice to the people who need it the most," said IRRI Director General Matthew Morell. "The rigorous safety standards observed by the US FDA and other agencies provide a model for decision-making in all countries wishing to reap the benefits of Golden Rice."

In a related development, the Minister of Agriculture for Bangladesh, Matia Chowdhury acknowledged the positive impact of biotech crops and their potential to help Bangladesh meet Zero Hunger by 2030.

"Bangladesh will march forward on Golden Rice," said H.E. Chowdhury. "Inspired by the success of the country's first commercially released biotech crop in 2013, Bangladesh is now field testing three more crops developed through applications of biotechnology, including Golden Rice. The government has every intention to support genetically modified crop cultivation in the future."

Golden Rice is intended as a complementary, food-based solution to existing nutritional interventions, such as diet diversification and oral supplementation. It achieves this by providing 30-50% of the estimated average requirement for Vitamin A of women and children.

IRRI is working with national research partners in the development and deployment of healthier rice varieties that have more iron, zinc, and beta-carotene content to improve the nutritional status of vulnerable populations with limited access to diverse diets. Because rice is already widely grown and eaten, these bio-fortified rice varieties have the potential to reach many people.



REINFORCING RICE RESEARCH PARTNERSHIPS TO BENEFIT SMALLHOLDER FARMERS AROUND THE WORLD

IRRI is working closely with the Rural Development Administration (RDA) in South Korea in advancing rice research to help more rice-growing countries. The IRRI-RDA collaboration will evaluate current projects and plan future initiatives on delivering impactful rice research.

“Through our partnership with IRRI, South Korea has revolutionized rice production and RDA came to have world-class rice breeding technology,” said RDA Director Jeom-Ho Lee. That 50-year partnership has led to solutions tailored to South Korea’s local needs such as the development of premium quality rice varieties (Gopumbyeo and Unkwangbyeo) and high-quality and high-yielding temperate japonica rice varieties that helped transform the country from a rice importer to a self-sufficient producer and exporter of rice. It also launched the Rice Technology Transfer System Workshops which has benefited around 130 practitioners from over 17 countries in Asia.

DRIVING AGRICULTURAL DEVELOPMENT ACROSS AFRICA



AfricaRice and IRRI have agreed to a step-change in their partnership to accelerate delivery on the rapidly growing needs of the African rice sector. The two CGIAR Centers will offer a comprehensive, pan-African, multi-focus program of research for development services aligned with national priorities.

The key areas of change will include more foresighting and capacity development services, addressing gender and youth opportunities, contributing to nutrition and health needs, providing evidence-based policy research, developing climate-resilient rice varieties, and assuring high-performance production systems and value chains to better link smallholder farmers to markets.

“Such a shift in our approach to the African rice sector will help achieve greater and more rapid impact across the value chain and facilitate stronger support and recognition of our joint efforts by our stakeholders,” said Harold Roy-Macauley, director general of AfricaRice.

In endorsing the new approach, IRRI Director General Matthew Morell said, “IRRI and AfricaRice are committed to harnessing our collective capacity to address the rice self-sufficiency needs of Africa and achieve it in an economically and socially sustainable manner.”

GLOBAL COLLABORATIONS FOR SUSTAINABLE DEVELOPMENT



INVESTING IN RESEARCH-FOR-DEVELOPMENT TO BOOST BANGLADESH AGRI-FOOD SECTOR

The importance of investing in research for development in the rice-based agri-food systems was highlighted at the *Mobilizing Resource for Research for Development in Rice-based Agri-food System to Achieve SDGs in Bangladesh*, a consultative meeting organized by IRRI and the Bangladesh Ministry of Finance and Planning, Economic Relations Divisions.

“This is a significant milestone in galvanizing efforts to deliver Zero Hunger and No Poverty in Bangladesh,” said Dr. Nafees Meah, IRRI representative for South Asia. “Zero Hunger and No Poverty in Bangladesh can be achieved through the transformation of the agriculture sector. Increasing investment in research for development on the rice-based agri-food system is a must, given the challenges facing the country. The payback would be immense.”

INCREASING FARMERS' INCOME THROUGH POSTHARVEST UPGRADING

IRRI joined fellow global experts at the 13th International Rice Conference for Latin America and the Caribbean to share solutions and approaches to sustainable rice production through recent developments in postharvest technologies and learning alliances. Alliances were also formed to create a platform for various rice value chain stakeholders, where participants may exchange market information. Through these alliances, farmers are able to form linkages and gain timely information on current demand and prices.

PAVING THE WAY FOR SUSTAINABLE RICE PRODUCTION IN ASIAN COUNTRIES

IRRI, in collaboration with its national partners, is implementing innovative pathways to alleviate poverty and promote gender equity by optimizing productivity and environmental sustainability of irrigated rice production systems. Funded by the Swiss Agency for Development and Cooperation, The Closing Rice Yield Gaps in Asia with Reduced Environmental Footprint (CORIGAP-PRO) project brought together national partners from eight countries during its annual meeting to discuss key outcomes and plan activities for the next year.

Planned activities include: (1) expansion of outreach and documentation of stories of change; (2) testing and documenting increased environmental sustainability by using the Sustainable Rice Platform indicators; (3) linking farmers group to premium markets; (4) inform policy advisors on key outcomes of the project; and (5) strengthening capacity of national partners.

REINVIGORATING NEPAL'S RICE SELF-SUFFICIENCY EFFORTS

Nepal's Ministry of Agriculture, Land Management, and Cooperatives and IRRI signed a 5-year collaborative work plan to reinvigorate Nepal's rice sector and help achieve food and nutrition security. It outlines projects specifically designed to increase grain yield, build technical skills and capabilities, and promote a more market-driven seed system for climate change-resilient rice varieties as a means to reduce Nepal's rice imports.

Awards and Accolades

Ruaraidh Sackville Hamilton, former head of the International Rice Genebank, received the Crop Trust Legacy Award for his outstanding contribution in the field of plant genetic resources conservation. At IRRI, he was involved in safeguarding rice genetic resources, facilitating their effective and responsible use in compliance with international obligations, and developing new approaches to improve their conservation and use.

“This Legacy Award signifies a global recognition of the Institute's work and commitment to conserve rice genetic diversity through the International Rice Genebank, which has been a significant force in shaping our future impact,” said Dr. Hamilton.

DR. RUARAIKH SACKVILLE HAMILTON RECEIVES CROP TRUST LEGACY AWARD



BANGLADESH HONORS DR. MD. M ABDUL MAZID FOR CONTRIBUTIONS TO NATIONAL FOOD SECURITY



The Bangladesh Government presented the Swadhinata Padak 2018 Award to Md. M Abdul Mazid, a former IRRI agronomist, for his work on rice research and development that helped improve food security in the country. Dr. Mazid was recognized for his work that spans over 40 years in developing the rice-based agri-food systems of Bangladesh. Among his accomplishments are mitigating Monga, the yearly cyclical phenomenon of poverty and hunger in Bangladesh, accelerating the development of rice varieties that can tolerate flash flooding, pioneering seed production, and training Bangladeshi farmers.

The Swadhinata Padak 2018 or Independence Award is the highest civilian honor the Prime Minister of Bangladesh bestows upon individuals who have made remarkable contributions in their respective fields.

Awards and Accolades

FORMER IIRI DIRECTOR GENERAL ROBERT ZEIGLER RECEIVES 5TH CLASS OF THE MOST NOBLE ORDER OF THE CROWN OF THAILAND



IIRI Representative for Southeast Asia Dr. David Johnson receives The Most Noble Order of the Crown of Thailand 5th Class on behalf of former IIRI Director General Dr. Robert "Bob" Zeigler.

For his significant contribution and leadership towards strengthening the Kingdom of Thailand's rice sector, the former IIRI Director General Robert Zeigler was conferred the Most Noble Order of the Crown 5th Class. In his more than ten years of service as IIRI Director General, Dr. Zeigler's valuable leadership and support of joint initiatives have enhanced the close partnership between Thailand and the Institute.

Such collaborations have led to breeding better rice varieties, development of rice protection systems, adoption of seed technology innovations, and capacity building of personnel from Thailand's Ministry of Agriculture and Cooperatives. This award also distinguishes IIRI as an organization that has been key to increasing yield and livelihood opportunities for Thai farmers.

STUDENT RESEARCH ON HERBICIDE EFFECTS ON AMPHIBIANS RECEIVES ENVIRONMENTAL AWARD

Molly Shuman-Goodier, a PhD student from the Northern Arizona University, was awarded the best PhD platform presentation during the Spotlight Session at the globally renowned Society of Environmental Toxicology and Chemistry.

The key findings of her doctoral dissertation, *Invasive cane toads: Good for something? Developmental assays reveal safety concerns of the common rice herbicide, butachlor*, support recent work indicating that the rice herbicide butachlor causes thyroid endocrine

disruption in vertebrates and that wildlife and human health are at stake when exposed to this herbicide in the rice fields. Ms. Shuman-Goodier is supported by IIRI's CORIGAP, a project funded by the Swiss Agency for Development and Cooperation.

IIRI-SUPPORTED RICE CORP WINS PRESTIGIOUS HULT PRIZE

The social enterprise Rice Corp was awarded the 2018 Hult Prize by former US President Bill Clinton for its proposal to deliver better sustainable drying technology to reduce rice loss while increasing farmer income in Myanmar.



LEADING WOMEN RICE SCIENTISTS RECOGNIZED FOR SOLUTIONS TO GLOBAL FOOD AND NUTRITION SECURITY

Tamal Lata Aditya of Bangladesh and Amitha Bentota of Sri Lanka were conferred with the Senadhira Rice Research Award, named after the late Dr. Dharmawansa Senadhira, for their innovative ideas and use of enabling technologies. Their body of work helped contribute to a reliable supply of high-quality and safe rice for a growing global population in the face of changing consumer needs, diminishing resources, and complex environmental challenges.

Dr. Aditya has significantly contributed to the development and dissemination of over 12 improved rice varieties and 12 promising advanced breeding

lines that primarily respond to drought and yield challenges. As the research director of Bangladesh Rice Research Institute (BRRI), she is instrumental in setting and implementing the institute's research agenda.

Over the course of her career, Dr. Bentota shifted from rice research to a position of policy leadership at the Department of Agriculture in Sri Lanka where she is currently the assistant director. Her area of focus as a rice breeder and geneticist is addressing iron toxicity and acidity in soils and improving yield in these unfavorable conditions.

Rice Corp, in partnership with IIRI, plan to bridge the gap between off-the-shelf rice drying technology and rice farmers that cannot afford the technology. Access to this leading edge drying technology reduce rice wastage and provides farmers in approximately 100 villages with better profitability for their crops.

THREE SCIENTISTS NAMED OUTSTANDING IIRI ALUMNI

IIRI recognizes outstanding people from the community of former staff, scholars, interns, trainees, and postdoctoral fellows for their scientific contributions in rice research and innovation,

particularly for work that has breathed life into IIRI's strategic goals. The Outstanding Alumni for 2018 are:

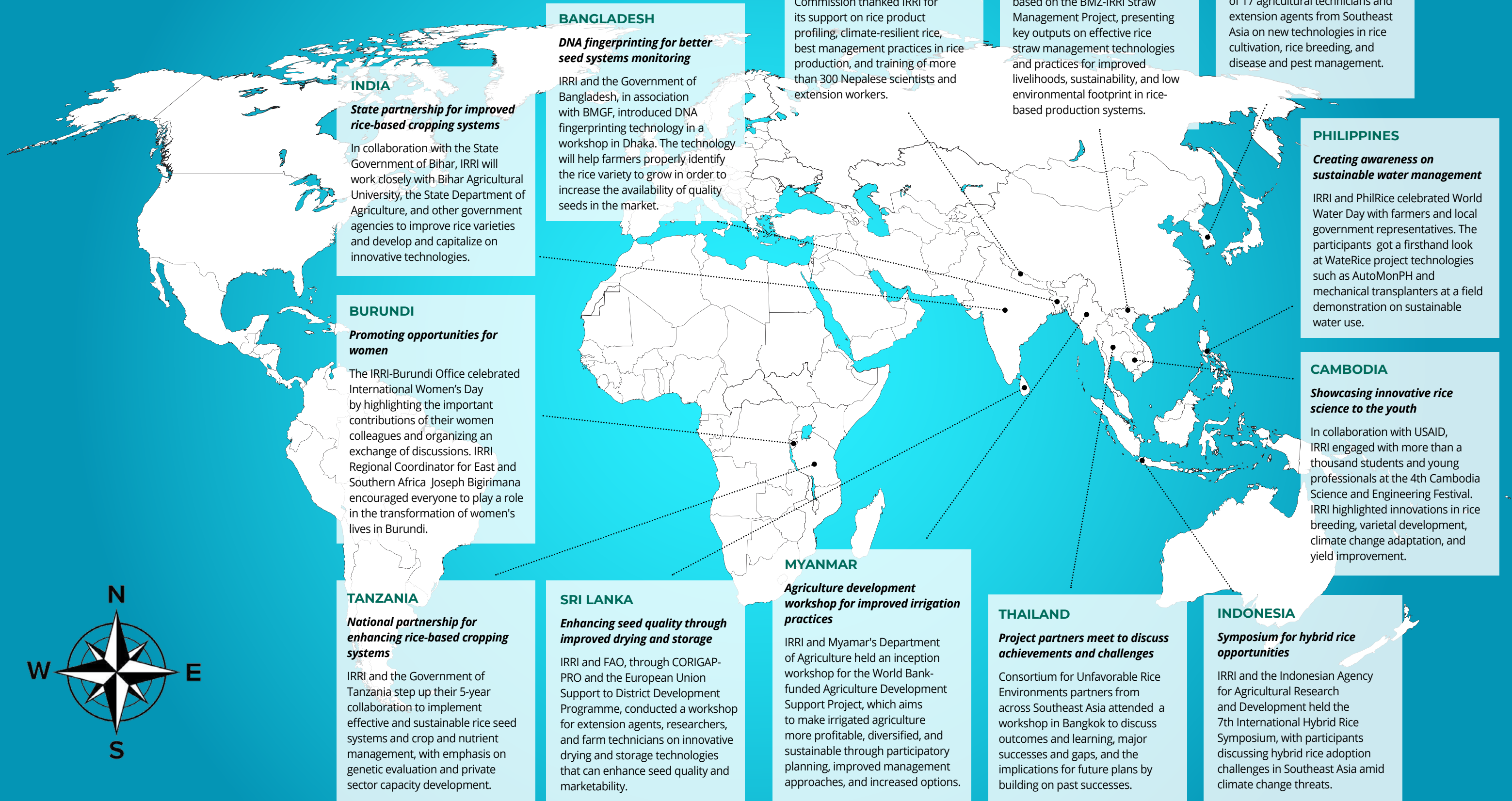
Dr. Muhammad Abdul Hamid Miah, former Executive Chairman of Bangladesh Agricultural Research Council and former Director General of BRRI and Bangladesh Jute Research Institute.

Dr. Phetmanyseng Xangsayasane, Deputy Director for Research, Rice Research Center, National Agriculture and Forestry Research Institute, Ministry of Agriculture and Forestry, Lao PDR.

Dr. John Munji Kimani, Director of Kenya Agricultural and Livestock Research Organization and Mwea - Industrial Crops Research Centre.

IRRI around the world

HIGHLIGHTS OF OUR IMPACT IN VARIOUS COUNTRIES



STATEMENT BY THE CHAIR OF THE IRRI BOARD OF TRUSTEES FOR 2018

In 2018, IRRI broke new ground with a range of achievements and activities. The institute strengthened its presence in new territories with the openings of the IRRI South Asia Regional Centre in India and the Africa Regional Office in Kenya. We secured landmark partnerships and funding from important stakeholders, like the Global Crop Diversity Trust and Bill and Melinda Gates Foundation (BMGF). In research we expanded the frontiers of rice science through advances in climate-smart tolerances, new populations and parental lines in hybrid rice, and big data for rice breeding.

FINANCIAL HIGHLIGHTS

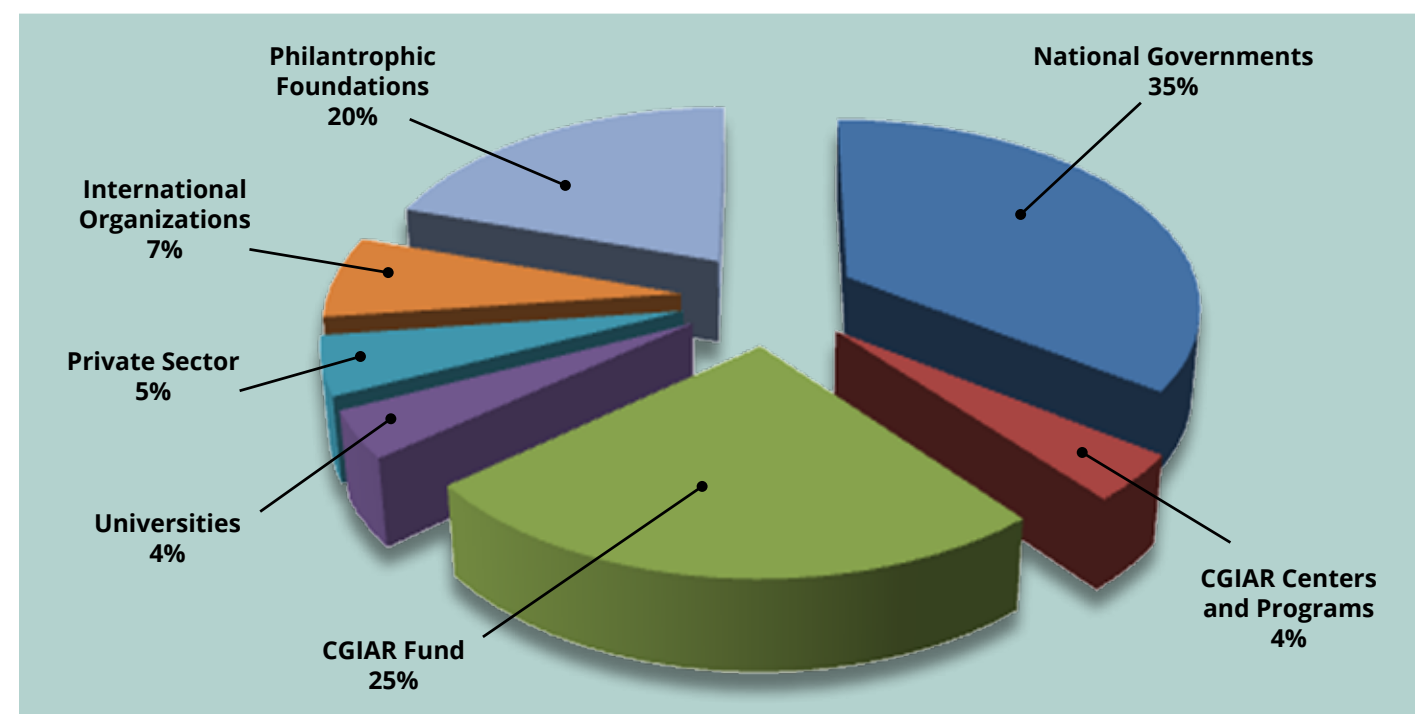
IRRI continues to be the lead center for the RICE CRP joined by the Africa Rice Center (AfricaRice), the International Center for Tropical Agriculture (CIAT), and hundreds of other partners across the globe. The RICE CRP has been approved for operation through 2021.

Despite budget cuts in the CGIAR Fund in 2018, IRRI's financial position remains stable, with total assets of USD 83.829 million compared with USD 87.896 million in 2017. The decrease of USD 4.067 million was offset by

a corresponding decrease in liabilities and a decrease in net assets. IRRI had a net deficit of USD 2.369 million. However, the liquidity and long-term stability indicators remained above CGIAR benchmarks.

In 2018, IRRI's grant portfolio was USD 67.464 million, which included USD 4.623 million of RICE CRP Windows 1 and 2 funds for the flagship expenses of our CGIAR partners, AfricaRice and CIAT. IRRI continued to successfully attract significant new donor investments to further its mission as well as to cover gaps due to the reductions in the CGIAR Fund budget in 2018.

In 2017, the Institute began converting its financial reporting to align with the International Financial Reporting Standard (IFRS). Full adoption of IFRS required the restatement of IRRI's 2016 Financial Statements and the 2015 Statement of Financial Position, which had been previously prepared in compliance with established CGIAR financial guidelines. In 2018, IRRI's financial statements became fully compliant. So, IRRI's financial statements are now aligned with international quality standards for financial reporting that are recognized



inter alia by donors, the banking industry, partners, and potential collaborators. Further, compliance to this standard allows for comparability with other organizations and enhances the annual audit report.

RESEARCH STRENGTHS

IRRI's cutting-edge science is widely reflected in the public record, especially through high-impact journals. For example, in the *Plant Biotechnology Journal* a new study led by IRRI scientists is predicting genetic regions that influence the glycemic index and texture of rice. Our scientists' discovery of variations in the *SWEET* genes that make rice resistant to devastating bacterial blight was featured in *PLOS One*. In *Nature*, we reported on the genomic variation in 3,010 diverse accessions of Asian-cultivated rice.

Throughout 2018, IRRI scientists published 223 scientific refereed journal articles, with nearly half of them available immediately through open access. Overall, IRRI's impact factor is increasing in quality and quantity, with a strong upward trend year after year.

KEY PROGRAMS AND INFRASTRUCTURE

Started in 2007, the Stress-Tolerant Rice for Africa and South Asia (STRASA) Project, created in collaboration with the BMGF and AfricaRice, is winding down its 10-year goal to uplift smallholder farmers' livelihoods by the development and delivery of improved rice varieties tolerant of abiotic stresses. The project's key achievements include the production and distribution of over 500,000 tons of stress-tolerant seeds to an estimated 18 million farmers, and the establishment of expansive and robust platforms for varietal knowledge enhancement, training, national and regional networks for product evaluation, seed production, and delivery.

Also concluding its Phase III stage in 2018 is the Green Super Rice (GSR) Project, an IRRI initiative in collaboration with the Chinese government and other partners. The development of GSR cultivars, a mix of over 500 rice varieties and hybrids that perform well with less inputs and provide multiple tolerances from biotic and abiotic stresses, are seen as an important adaptation strategy to climate change. Building on the work of the previous phases, Phase III achievements include the development and dissemination of hundreds of inbred and hybrid GSR varieties in various countries across Southeast Asia, South Asia, and Africa, with more than a million hectares devoted to these climate-smart cultivars.

Top infrastructure advancements this year are the inauguration of the IRRI South Asia Regional Centre in Varanasi, India, and the opening of the Africa Regional Office in Nairobi, Kenya. These new IRRI hubs will help strengthen and augment our research expertise, technology transfer, and capacity building activities in these regions, as well as facilitate South-South collaboration and multi-sectoral and public-private partnerships.

Operating within our commitments as a public institution, IRRI is developing equitable collaborations with private sector partners in order to harness key innovations that can advance our goals. An agreement with Corteva Agriscience will accelerate both parties' rice breeding efforts by the sharing of key technologies, while an agreement with Computomics will allow their machine learning AI to access data from our rice genebank and predict potential breeding crosses faster and more efficiently.

A major accomplishment in 2018 in the area of infrastructure was securing perpetual financial support from Global Crop Diversity Trust for the maintenance and operation of the International Rice Genebank. The grant, amounting to a generous USD1.4 million annually in perpetuity (provided we maintain set benchmarks) is a significant achievement for IRRI, as we are the first CGIAR center to receive such an agreement, attesting to the high standards and quality of our genebank operations.

CONGRATULATIONS AND THANKS

In 2018, IRRI completed the second year of its compelling Strategic Plan, which is designed to transform lives through the global rice sector. The Board congratulates the staff, which has admirably and successfully dealt with the many changes and challenges that the plan has brought.

In addition to the committed staff and management, the Board earnestly thanks IRRI's partners, donors, and investors for their amazing support for helping the Institute realize its indispensable mission.


Jim Godfrey
 Chair
 IRRI Board of Trustees

For the complete Audited Financial Statement, see link: http://books.irri.org/AR2018_audited-financial-statements.pdf

OUR INVESTORS

We are grateful to governments, international institutions, and public and private organizations for their trust and confidence in our ability to create long-term and sustainable impact towards global food security and the alleviation of hunger and poverty across the rice-growing world.

Bill & Melinda Gates Foundation		
Republic of India • Assam Rural Infrastructure & Agricultural Services Society	• Department of Biotechnology • Department of Agriculture, Cooperation, & Farmers Welfare	• Government of Andhra Pradesh • Government of Odisha • Indian Council of Agricultural Research
Federal Republic of Germany • German Federal Ministry for Economic Cooperation and Development	• DA Bureau of Agriculture Research • DA Bureau of Plant Industry • DA Philippine Rice Research Institute • Land Bank of the Philippines • Regional Field Offices - ARMM, I, II, V, VIII, IX, XI, XII, XIII	• Ministry of Agriculture, Forestry and Fisheries • National Institute for Agro-Environmental Sciences
Global Crop Diversity Trust	State of Japan • Japan International Cooperation Agency • Japan International Research Center for Agricultural Sciences	Swiss Confederation • Swiss Agency for Development and Cooperation
People's Republic of China • Chinese Academy of Agricultural Sciences	The World Bank	United States of America • United States Agency for International Development
Republic of the Philippines • Department of Agriculture (DA) Agricultural Training Institute	Organization of the United Nations International Initiative for Impact Evaluation (3ie) International Fund for Agricultural Development Kingdom of Thailand Lee Foundation People's Republic of Bangladesh Portuguese Republic • Instituto de Investigacao Cientifica Tropical Provivi, Inc. Reliance Industries Limited Republic of Indonesia Republic of Korea • Rural Development Administration	Republic of Mozambique Republic of Turkey Republic of the Union of Myanmar • Ministry of Agriculture, Livestock, and Irrigation Rothamsted Research Limited Socialist Republic of Vietnam Syngenta United Kingdom of Great Britain and Northern Ireland • Biotechnology and Biological Sciences Research Council United Nations Entity for Gender Equality and the Empowerment of Women United Nations Environment Programme
Access Agriculture African Development Bank Asian Development Bank AXA Research Fund Bayer Catholic Relief Services Commonwealth of Australia • Australian Centre for International Agricultural Research • Commonwealth Scientific and Industrial Research Organisation Council of Agriculture of the Republic of China DKT Liberty Project European Commission Food and Agricultural		

OUR PARTNERS

We work with organizations and institutions from around the globe to drive research and innovation for humanity's most important food crop. These partners provide valuable support and collaboration that expand and accelerate the institute's impact to farmers and communities across the rice-growing world.

CGIAR Centers and Programs	Universities
AfricaRice Bioversity International CGIAR Fund HarvestPlus International Center for Tropical Agriculture International Crops Research Institute for the Semi-Arid Tropics International Food Policy Research Institute International Institute of Tropical Agriculture International Maize and Wheat Improvement Center WorldFish	Cornell University Cranfield University Heinrich Heine University of Duesseldorf Kansas State University Nagoya University National Academy of Sciences, USA New York University The National Institute of Agricultural Botany Pennsylvania State University Université Catholique de Bukavu University of California, Berkeley University of Cambridge University of Nottingham



1035
IRRI STAFF WORLDWIDE

113
RECRUITED GLOBALLY

922
RECRUITED LOCALLY

39
NATIONALITIES

17
OFFICES WORLDWIDE

77
NEW STAFF

12
KEY POSITIONS FILLED

42%
ARE WOMEN

22%
ARE 30 OR BELOW

Great people, great purpose

At IRRI, people are our greatest asset. To deliver on our mission, we strive to hire and develop people who excel in their area of expertise, who are committed to the institute's mission and purpose, and who relish working across boundaries—whether scientific, functional, geographic, or cultural—as part of a vibrant team.



IRRI aims to improve livelihoods and nutrition, abolishing poverty, hunger, and malnutrition among those who depend on rice-based agri-food systems. In doing so, IRRI's work protects the health of rice farmers and consumers, and the environmental sustainability of rice farming in a world challenged by climate change. IRRI's work promotes the empowerment of women and supports opportunities for youth in an equitable agri-food system.

irri.org