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The Symposium in Retrospect

The UN Food Systems Summit held in September 2021 affirmed the urgent need for the transformation of our current food systems as indispensable solutions for achieving the Sustainable Development Goals (SDGs). Many countries including Japan announced their commitments towards sustainable food systems that enable both human and planetary health, and the role of science, technology, and innovation has been reiterated at various occasions as a solution towards achieving such goals.

Given the above trends, JIRCAS held its International Symposium 2021, with the theme “The Role of Science, Technology and Innovation in Achieving Sustainable Food Systems in the Asia Monsoon Region: A Platform for International Collaboration,” under the auspices of the Ministry of Agriculture, Forestry and Fisheries, the National Agriculture and Food Research Organization, and the United Nations Food and Agriculture Organization Liaison Office in Japan. The Asia monsoon region is distinguished by its high summer rainfall, rice-based agriculture, and large number of small- and medium-sized farmers, with significant intra-regional heterogeneity in agroecological and socio-economic conditions. At the symposium, participants discussed the importance of adapting to each country's situation, acknowledging that there is no “one-size-fits-all” solution.

In retrospect, JIRCAS has already been conducting its research exactly in line with these directions for decades. Our research results include technologies for climate change mitigation and adaptation, integrated management of cross-border pests, efficient application of chemical and organic fertilizers, crop cultivars resilient to unfavorable conditions, water-saving irrigation, recycling of agricultural residues, reclamation and maintenance of tropical forests, and



environmentally friendly aquaculture, as well as research associated with various socio-economic and human studies. The results have been achieved through field-oriented, equal-footing collaborative research projects with local counterpart institutions in developing regions.

JIRCAS has committed itself to collecting and analyzing information on issues and challenges affecting the agriculture, forestry and fisheries sectors and global food systems in an increasingly complicated and multifaceted world, and to providing strategic and evidence-based information to domestic and international partners as an opinion leader. We hope that the symposium had provided a forum to think about the realization of sustainable food systems through innovations that will improve both agricultural productivity and sustainability in the Asia monsoon region and the creation of a platform for collaboration that will contribute to the MeaDRI Strategy (Measures for achievement of Decarbonization and Resilience with Innovation).

HiYAMA Miyuki
Program Director/Information



Symposium panelists

JIRCAS International Symposium 2021 Report

JIRCAS International Symposium 2021, themed “The Role of Science, Technology and Innovation in Achieving Sustainable Food Systems in the Asia Monsoon Region: A Platform for International Collaboration,” was successfully held online on November 17, 2021. Dr. Bal Antonio, JIRCAS Communications Advisor, emceed the event. For the first time, the symposium was recorded in advance and streamed on the JIRCAS YouTube channel. Many people, including those who could not register for the symposium, viewed the archived video afterwards.

The world has been moving in earnest towards the realization of a decarbonized society, with countries and regions working together at the COP 26 in Glasgow, UK, in November 2021 to accelerate global climate action. In the field of agriculture, forestry, and fisheries, the United Nations Food Systems Summit was held in September 2021 to discuss the state of the food systems and how they contribute to human and planetary health. Aware of these global trends, the Ministry of Agriculture, Forestry and Fisheries of Japan formulated the MeaDRI Strategy (Measures for achievement of Decarbonization and Resilience with Innovation) on May 12, 2021, aiming to build sustainable food systems through innovations that can reduce the environmental burden, such as carbon neutrality, without affecting productivity. In this context, this symposium highlighted the Asian monsoon region, including Japan, and discussed the need for a regional platform to share lessons on innovations that can improve both agricultural productivity and sustainability.

Following the opening remarks by President KOYAMA Osamu of JIRCAS, Mr. AOYAMA Toyohisa, Director-General of the Agriculture, Forestry and Fisheries Research Council Secretariat, spoke on behalf of the Ministry of Agriculture, Forestry

and Fisheries (MAFF) about the significance of the research that JIRCAS has been conducting for the past half century to improve agriculture, forestry and fisheries technologies around the world and to increase food production.

In the keynote speeches, Prof. Joachim von BRAUN, Chair of the Science Group of the UN Food Systems Summit, and Mr. OSAWA Makoto, Former Vice-Minister for International Affairs, MAFF, spoke about the importance of science and technology innovation and dialogue between science and policy stakeholders to realize sustainable food systems that are resilient to disasters and climate change, based on global discussions.

In addition, on behalf of agricultural research and development organizations working in the Asian monsoon region, presentations were made by Mr. Sridhar DHARMAPURI (Food and Agriculture Organization - Regional Office for Asia and the Pacific), Dr. Jon HELLIN (International Rice Research Institute), Mr. UEDA Yasunari (Japan International Cooperation Agency), Dr. SHIRATO Yasuhito (National Agriculture and Food Research Organization), and Dr. HAYASHI Keiichi (JIRCAS). In the panel session facilitated by Dr. IYAMA Miyuki (JIRCAS), the panelists explored innovations that would both improve agricultural productivity and sustainability in the Asian monsoon region, and discussed the ideal collaborative platform that would contribute to the “MeaDRI Strategy.”

The symposium was concluded by JIRCAS Vice President YAMAMOTO Yukiyo, who also expressed her appreciation to the speakers, panelists, and viewers in her closing remarks.

KANAMORI Norihito
Project Leader, Information Hub



JIRCAS President KOYAMA Osamu



AFFRCS Director-General AOYAMA Toyohisa



JIRCAS Vice-President YAMAMOTO Yukiyo



JIRCAS Communications Advisor Bal ANTONIO (Symposium Emcee)

Keynote Speech 1

Research priorities in support of global and regional food systems transformations

The UN Food Systems Summit in September 2021 focused on the Sustainable Development Goals (SDGs), in particular Goal 2: “End hunger, achieve food security and improved nutrition, and promote sustainable agriculture,” which is closely related to climate change and biodiversity issues. It also touched on the topic of why the market cannot account for the true cost of food in today’s food systems. One estimate puts the true cost of food at \$28 trillion per year, compared to a market value of \$9 trillion. The externalities that make sustainable and healthy food expensive and unsustainable and unhealthy food very cheap is a major problem that must be addressed.

The food systems we are concerned with are closely related to the “health systems,” the “economic and governance systems,” the “science and innovation systems,” and the “ecology and climate systems.” In this context, the science and innovation system is central to the means of accelerating the implementation of food system transformation to achieve the SDGs.

The Scientific Group of the UN Food Systems Summit forwarded seven major science and innovation proposals for the UN Food Systems Summit (Table). Among them, there are growing expectations for bioscience innovations to improve human and planetary health, and digital innovations to improve the efficiency and inclusiveness of food systems and rural communities.

However, social dialogue is also needed to convince the

public of transparency, ethical standards, and necessary regulatory policies. It will also be necessary to overcome inequitable access to digital technologies. It is essential to ensure inclusiveness so that no one is left behind.

The highlight of this year’s UN Food Systems Summit is conveyed in the Secretary-General’s Statement of Action. The Secretary-General set out five action areas, namely, nourish all people; boost nature-based solutions; advance equitable livelihoods, decent work, and empowered communities; build resilience to vulnerability shocks and stresses; and accelerate the means of implementation. Supporting the means of implementation, which involves science, emphasizes the importance of strengthening the capacity of science policy. In other words, global efforts to increase ambition in providing science-based solutions will be key to achieving the 2030 Agenda.

Science will be at the heart of the follow-up to the UN Food Systems Summit over the next 10 years. Although the idea of the summit is to be implemented at the national level, there is a need not only for a stronger framework for integration into national development policies, but also for a new, comprehensive, global science-policy interface to achieve sustainable food systems.

Prof. Joachim von BRAUN
Chair, Scientific Group, UN Food Systems Summit

Table. Seven Major Science and Innovation Proposals

1	A bundle of contact-specific policy and institutional innovations to end hunger and increase availability and affordability of healthy diets and nutritious foods
2	De-risking the food systems
3	Efficient and fair land credit and labor arrangements
4	Bioscience innovations for human and planetary health
5	Technology based on policy innovations for productive soils, land and water to protect the agricultural genetic base and biodiversity
6	Sustainable fisheries and aquaculture
7	Digital innovations for efficiency and inclusiveness of food systems and rural communities



Joachim von BRAUN

Keynote Speech 2

UN Food Systems Summit is only the first step

The UN Food Systems Summit in September 2021 was the first summit on food systems, reflecting the widespread recognition of the interconnectedness of various agricultural and food-related issues through changes in the world's diet. One of the reasons for holding the summit was the widespread recognition that various problems related to agriculture and food, such as hunger, obesity, food loss, deforestation, water shortage, and loss of biodiversity, are all connected through changes in the world's dietary habits. The other is the growing awareness that agricultural production is one of the major causes of global environmental problems that need to be solved.

Looking at the world, there is a movement to limit the production and trade of agricultural products mainly in Europe for the purpose of environmental protection. The EU's Farm to Fork strategy is a good example of this. Furthermore, in relation to the Convention on Biological Diversity (CBD), discussions on the post-Aichi Biodiversity Targets have begun, including discussions on reducing the use of pesticides and fertilizers and agricultural subsidies because of their potential negative impact on the environment.

In response to these international movements, Japan formulated the MeaDRI Strategy (Measures for achievement of Decarbonization and Resilience with Innovation) in May 2021, to achieve both productivity and sustainability by

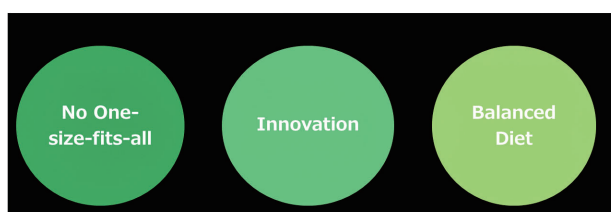
changing the entire system from food procurement to production, distribution, processing, and consumption using innovation as a lever, with the goal to be carbon neutral by 2050. It includes (1) a no one-size-fits-all solution, taking into account the importance of regional conditions, (2) the promotion of innovation, and (3) a balanced diet (see Figure). These are also reflected in the UN Secretary General's Statement of Action.

However, as this is only the first step, there is a need to innovate in line with the production and consumption patterns and conditions of the region. In order to realize the transformation of the food systems in the Asian monsoon region and the world, it is necessary to (1) realize that the stage is the Asian monsoon region and not the area of a single country, (2) pay attention to the entire food system and not just to agricultural production, (3) make the necessary investments in sustainable agricultural production, (4) recognize the importance of solving environmental problems, and (5) expand the scope of cooperation between industry, academia, and government.

OSAWA Makoto
*Former Vice-Minister for International Affairs,
 Ministry of Agriculture, Forestry and Fisheries
 (MAFF), Japan*



Summary of Japan's Basic Position vis-à-vis Sustainable Food System



(Figure)



OSAWA Makoto

Under the theme “Innovation for Sustainable Food Systems in the Asian Monsoon Region,” representatives of agricultural research and development organizations working in the Asian monsoon region spoke about their efforts to achieve the common goal of improving productivity and sustainability.

Presentation 1 Transforming agri-food systems in the Asia-Pacific

The Asia-Pacific region is comprised of a very diverse mix of low-, middle-, and high-income countries. There are countries with serious humanitarian crises and emergencies, while at the same time there are countries that are members of the G20 and G7. Demographics also vary, with some countries having high and low population densities, and some having large elderly populations and others having large young populations. About 2 billion people in the region depend on agriculture for their livelihoods, but there is a high burden of malnutrition, including undernutrition, micronutrient deficiency, obesity, and being overweight. About 350 million people are hungry, undernourished, or malnourished, the highest number in the world. This situation is exacerbated by the global epidemic of the new coronavirus infection (COVID-19).

Agriculture in the region is vulnerable to severe depletion of natural resources, climate damage, and transboundary pests and diseases. In addition, greenhouse gas emissions from agriculture account for almost 40% of the world's total emissions. For this reason, the UN Food

Systems Summit called for high-level action to transform the food systems into one that is more efficient, inclusive, resilient, and sustainable so that no one is left behind. Innovation is needed to enhance efficient and sustainable production and consumption, address climate change, improve resilience, and increase incomes and employment. These have been adopted by FAO as part of its new strategic framework, and the FAO Regional Office for Asia and the Pacific is also supporting the 46 member countries of the Asia and Pacific region. Science and technology are indispensable for this innovation, and science and technology innovation encompasses traditional knowledge, good practices, mechanization, visualization using digital tools, evidence-based policies and advice, and much more.



Sridhar DHARMAPURI

Presentation 2 Creating opportunities for transformative climate adaptation and mitigation by farmers in the Asian Monsoon Region

Various agricultural technologies and measures can be used to mitigate and adapt to climate change and help with food security. Much of the research on climate-smart agriculture (CSA) has focused on the number of farmers who have adopted this approach and the area that has been devoted to it. The reality, however, is that there are often more subtle consequences, such as trade-offs or better termed as ‘maladaptation.’

Farmers are not uniform throughout. They are divided by gender and power, or constrained by agroecological, socioeconomic, political, or a variety of other circumstances that make certain groups of farmers more vulnerable. Those who are in a position to access and use climate-smart agricultural knowledge, tools, etc. often benefit more, while the opportunities for the vulnerable to benefit are limited. If insufficient attention is paid to the root causes, interventions can replicate or exacerbate these vulnerabilities and inequalities. We need to think about who is most at risk, why they are particularly vulnerable, what are the economic, political, and technological factors, and how to strengthen resilience to climate change so as

not to repeat or exacerbate such vulnerabilities and inequities.

This is where the importance of interdisciplinary research to address the root causes of vulnerability, i.e., a mixture of natural and social sciences, comes into play. Each of the studies we are doing is necessary, but they are not well connected. We need to combine them and investigate their synergies, like completing a jigsaw puzzle.

It goes without saying that further progress towards the realization of the Sustainable Development Goals will depend on the interaction between researchers and various other stakeholders such as policy makers and NGOs. Building relationships from the early stages will make the research results more important and interesting.



Jon HELLIN

Presentation 3

Prioritized initiatives in the field of agricultural and rural development in the Asian monsoon region

The Japan International Cooperation Agency (JICA) had set four goals for technical cooperation in the field of agriculture and rural development in 2021, including “Establishing an inclusive food value chain or FVC that includes small-scale farmers as participants and beneficiaries.”

More than 90% of the world's farmers are family or individual farmers, and more than 375 million family farmers make their living on less than one hectare of land. On the other hand, consumer needs for food in developing countries are diversifying and increasing due to the expansion of the middle class accompanying economic growth. As a result, a food value chain from production to processing, distribution, and consumption of agricultural products is being established. In order to build a food value chain in which even small-scale farmers can participate, JICA has launched two priority initiatives: “Small-holder Horticulture Empowerment and Promotion” and “Establishment of the food value chain (FVC) in Southeast Asia.”

In building a sustainable food system, it is also necessary to promote innovations to reduce environmental impacts such as those that promote carbon neutrality and resilience. JICA is pursuing the promotion of innovation through the “Science and Technology Research

Partnership for Sustainable Development (SATREPS).” The expected results from SATREPS include policy recommendation and implementation for partner countries based on scientific evidence; the development of products and technologies and their application to the real world; the utilization of Japanese technologies; and the formation of development cooperation projects using the results of SATREPS.

However, developing countries have diverse issues and needs. In order to address these challenges, the JICA Platform for Food and Agriculture (JiPFA) was established in 2019 to promote information sharing and collaboration on food and agriculture among various stakeholders in Japan, including private companies, research institutions, and government agencies. In addition, the “Agriculture Co-creation Hub” has been established at JICA Tsukuba in 2020 as a platform for business matching in agricultural technology, training in new agricultural technologies, and human resource development in the field of agricultural development.



UEDA Yasunari

Presentation 4

Wise soil management for achieving triple wins in agriculture - food security, adaptation and mitigation

While food security is of paramount importance, it is imperative that farmers, as producers, adapt to climate change, maintain productivity, and avoid the severe impacts of greenhouse gases caused by climate change.

Although there are various technologies to mitigate greenhouse gas emissions from agriculture, reducing methane emissions through better water management in paddy fields is considered to be one of the promising approaches that can be widely applied in monsoon Asia. Alternate wetting and drying (AWD) technology is a technique that repeatedly controls the water level in paddy fields by intermittent irrigation to save water. The International Rice Research Institute (IRRI) is currently taking the lead in disseminating this technology, and our research has shown that AWD can reduce total methane emissions from rice paddies by an average of 30% in four Asian countries (Vietnam, Thailand, Philippines, and Indonesia).

In addition, storing carbon in soil is one of the attractive ways to improve soil productivity and promote win-win relationships for climate change mitigation. Long-term field experiments are important to demonstrate the effectiveness of such management practices. The

Rothamsted Research in the UK has been conducting long-term field monitoring since 1843, and we felt the need for such experiments in Asia as well, so we launched the Asian Long-Term Experimental Network for Agriculture (ALTENA) in 2017. We believe that networking long-term experiments in Asian countries will add new value to good and wise soil management to sustain our food and livelihoods.

To support decision making by producers and policy makers, we have also developed a website that allows users to easily calculate soil carbon and other greenhouse gases with trade-offs using a simple, user-friendly interface. The system is based on modeling studies of carbon and nitrogen dynamics in soils, with field monitoring data and mechanistic studies forming the basis for the modeling studies. These tools will help producers and policy makers to make decisions to change agricultural management in a sustainable way.



SHIRATO Yasuhito

Presentation 5

Working for small-scale farmers towards sustainable food system in Asia Monsoon Region

Since 1970, JIRCAS has been contributing to global agricultural research by working with regional and international partners based on a better understanding of local conditions, especially the problems and needs of farmers. The Asian monsoon region is one of the strategic regions where JIRCAS has established a base and good, friendly relations over the past decades, encouraging international cooperation with partners to develop agricultural technologies suitable for smallholder-based food systems.

Rice production is the core of the agriculture and food system in the Asian monsoon region and also one of the major contributors to methane (CH₄) emissions, a greenhouse gas (GHG). We have been addressing this issue with the use of alternate wetting and drying (AWD) technology, which has significantly reduced GHG emissions while maintaining or improving grain production. Currently, we are working to promote the use of AWD in Vietnam and Cambodia. We are also working to address the issue of enteric fermentation of livestock products, which is one of the main reasons for high methane emissions from the Asian monsoon region. Besides methane, nitrous oxide (N₂O) emissions cause global warming. Therefore, we tried and have succeeded in developing BNI-enhanced wheat that can grow better than its parent varieties without or with less

nitrogen fertilizer, a source of N₂O emissions, and obtain higher grain yields, as well as nitrogen use efficient rice that shows higher yields with the same amount of nitrogen fertilizer. JIRCAS is also engaged in research on transboundary pests that threaten the food systems in the Asian monsoon region, including Japan, and in the development of technologies necessary for the creation and production of resilient crops that are resistant to poor environments and other factors.

The foundation of JIRCAS is a holistic research system that encompasses natural and social sciences in various fields of agriculture, forestry, and fisheries, and boasts more than 50 years of experience in international research with various partners. One of our strengths is our flexibility and adaptability. We will continue and strengthen collaboration with other national institutions such as the National Agriculture and Food Research Organization (NARO) and the Japan International Cooperation Agency (JICA), and international organizations such as IRRI, One CGIAR and FAO, and effectively use our research results to solve global challenges.



HAYASHI Keiichi

Panel Discussion

In the panel discussion, representatives of prominent organizations working in the Asian monsoon region were invited to exchange views on the nature of the platform for international collaboration contributing to the MeaDRI Strategy.

The facilitator, Dr. IYAMA Miyuki (Director of JIRCAS Information Program), first asked all panelists for their opinions on how to overcome the trade-offs in adopting scientific and technological innovations.

Mr. Dharmapuri stressed the importance of a strategic approach to meet the needs of each country according to its stage of economic development, e.g., digital agriculture in the processing stage for emerging countries, smart technology for aging societies, etc. Dr. Hellin emphasized the need to consider the socio-economic context as well as the technical aspects in encouraging farmers to adopt innovations, and that an interdisciplinary approach is the key to resolving trade-offs. Mr. Ueda pointed out that innovations that claim to be sustainable and environmentally friendly are often technically difficult for farmers to implement, and that it is important to enable farmers to benefit from the value and advantages of innovations through consumer behavior change. Dr. Shirato stressed the importance of policy measures, such as subsidies and loan programs, and that farmers should be incentivized to continue adopting such technologies. Dr. Hayashi spoke of the importance of customizing technologies to local conditions and involving stakeholders such as extension agents and policy makers in order for farmers to take ownership.

Next, each panelist was asked about the concept of a regional platform where science and technology innovations and lessons can be shared. The panelists' comments were as follows:

“There is a need for strategic discussions on how to transform the food systems through collaboration between policy and research institutions such as UN agencies.” (Mr. Dharmapuri)

“It is important for stakeholders with different interests to work together with honesty and openness by sharing the same goal of sustainably transforming the food systems as a region.” (Dr. Hellin)

“We need to share the same goals to achieve collaboration between farmers and the private sector in the rapidly growing food value chain in the Asian monsoon region.” (Mr. Ueda)

“When transferring technology from one country to another, it is important to have a system that allows partners to share information on what socioeconomic and technological backgrounds farmers will actually adopt the technology.” (Dr. Shirato)

“As a member of Asia, Japan needs to join hands with countries in the Asian monsoon region to promote agricultural research.” (Dr. Hayashi)

At the end of the panel discussion, Dr. Iiyama acknowledged that there are many policy, research, and development partners in the Asian monsoon region with experience in applying innovation to achieve sustainable development, and that existing expertise in the science-policy interface should be leveraged. She concluded the session by emphasizing that the experience of achieving sustainable food system transformation in the Asian monsoon region should provide significant lessons for the international community, and that the symposium has provided a forum for partners with diverse comparative advantages to launch a network in pursuit of common goals.

JIRCAS TODAY

[Research Highlights]

World's First Successful Development of Wheat That Shows High Productivity with Less Nitrogen Fertilizer — Use of ammonium to prevent nitrogen pollution and increase food production at the same time —

JIRCAS, in collaboration with the International Maize and Wheat Improvement Center (CIMMYT), University of the Basque Country, and Nihon University, has succeeded in developing biological nitrification inhibition (BNI)-enhanced wheat that shows high productivity even when the amount of nitrogen fertilizer is reduced.

The BNI-enhanced wheat was obtained by intergeneric cross of a closely related wild wheat species (*Leymus racemosus*) with high BNI potential and a high-yielding wheat cultivar with BNI capacity. As a result, we were able to identify the chromosome region that controls the BNI ability of the wild wheat, which enabled us to introduce the BNI ability by crossbreeding.

In addition, BNI-enhanced wheat improves soil ammonium concentration by delaying ammonium nitrification in the soil, thereby increasing wheat productivity even in low nitrogen environments. This research is also positioned as part of the “Strategy for Sustainable Food Systems, MeaDRI” of the Ministry of Agriculture, Forestry and Fisheries.

By adding the BNI ability derived from the wild wheat to various wheat cultivars for the world's approximately 225 million hectares of wheat-growing areas, we can expect to reduce greenhouse gas emissions from wheat farming and water pollution caused by nitrification, and mitigate global warming while improving productivity.

The results of this study were published in the online edition of the scientific journal *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* on August 24, 2021 (Japan time).

Elucidation of the Unique Reproductive Behavior of Desert Locust — Efficient pest control that can lead to reduction in use of pesticides —

JIRCAS, in collaboration with the Mauritanian National Desert Locust Centre (CNLA), the French Agricultural Research Center for International Development (CIRAD), and the National Centre for Locust Control of Morocco (CNLAA), has clarified previously unknown mating and egg-laying behavior of desert locust in the field.

As a result of field surveys in the Sahara Desert, we found that sexually mature adults of desert locusts formed groups with a biased sex ratio toward males and females. In the female-biased population, most of the female locusts were developing ovaries and did not mate. On the other hand, in the male-biased population, the female locusts had large eggs just before spawning, and most of them were mating. Detailed investigation revealed that female locusts flew to the male population during the day just before egg laying, mated, and laid eggs in pairs at night. When desert locusts are mating, the male locusts cling to the female's back so that the female cannot fly away and be easily attacked by birds and other natural enemies. When male and female locusts live together, the male locusts relentlessly press the female locusts to mate, so it is thought that the female locusts avoid mating by living separately from the male locusts while their ovaries are developing, and lay eggs only when they are guarded by the male locusts to ensure safety. It can be inferred that female and male locusts live separately in groups to resolve conflicts and to meet their partners efficiently.

From the perspective of pest control, it is more efficient to wait for the timing of egg-laying at night, instead of immediately controlling the male locust population when it is found during the day. The application of the desert locust ecology is expected to lead to natural and environment-friendly pest control that does not require the use of pesticides more than necessary.

The results of this research have been published in the online edition of the *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* on October 12, 2021 (Japan time).

New Rice Varieties Released in Madagascar — “FyVary” varieties show high productivity under nutrient deficiencies —

JIRCAS, in collaboration with the National Center for Applied Research and Rural Development (FOFIFA) and the International Rice Research Institute (IRRI), has developed two new rice varieties, which have been registered in Madagascar on November 4, 2021, and released on the same day in the presence of the Deputy Minister of Higher Education and Scientific Research and the Minister of Agriculture, Livestock and Fisheries of Madagascar. The new varieties have attracted a lot of interest from farmers and government agencies in charge of extension as an achievement that will contribute to improving the productivity of rice, the staple food of Madagascar, and was picked up by local media including newspapers.

The two new varieties are FyVary32 and FyVary85. The word “FyVary” means “tasty rice” in Malagasy, the national language of Madagascar.

The FyVary32 variety was selected and bred from a cross between IR64, a major high-yielding rice variety in the tropics, and two lines that introduced the *Pup1* locus (chromosomal region) that increases phosphate absorption. On the other hand, FyVary85 was selected and bred from a cross between IR64 and DJ123. Both varieties show excellent productivity even in environments where nutrients from soil and fertilizer are scarce, which is a problem in paddy rice cultivation in Madagascar and many other African countries.

As a result of repeated productivity tests at 18 sites in three cropping seasons in farmers’ fields in Madagascar, FyVary32 showed 12% higher yield (average yield 3.67 t/ha), 4 days shorter number of days from seeding to flowering, and 20% higher yield (average yield 3.67 t/ha) than X265 (average yield 3.36 t/ha), the main rice variety in Madagascar. FyVary85 was demonstrated to have 20% higher yield (average yield 3.97 t/ha) and 5 days longer number of days from sowing to flowering. Furthermore, taste tests with farmers confirmed that FyVary85 has excellent palatability, and the Seed Management Committee of the Ministry of Agriculture and Livestock of Madagascar judged that there is sufficient potential for the variety to be disseminated to paddy rice farmers in Madagascar, leading to its registration.

JIRCAS will continue to produce certified seeds of the new variety and disseminate them to farmers in collaboration with FOFIFA, the Ministry of Agriculture and Livestock, and JICA’s technical cooperation project.

Madagascar is a rice-growing country where per capita rice consumption is more than twice that of Japan and more than half of the population is engaged in rice cultivation. However, the productivity of rice, the staple food and staple industry of the people, has stagnated to date. The spread of new rice varieties is expected to contribute to stable rice production, food security, and poverty reduction in Madagascar.

Life-Cycle Assessment of Greenhouse Gas Reduction Potential of BNI-Enabled Wheat — Wheat with 40% nitrification inhibition rate will lead to a 9.5% reduction in GHG emissions from wheat production worldwide —

JIRCAS, in collaboration with the International Maize and Wheat Improvement Center (CIMMYT), has developed a new model based on life-cycle assessment (LCA) to evaluate the total greenhouse gas (GHG) emissions generated at each stage of wheat production for biological nitrification inhibition (BNI)-enabled wheat, which shows high productivity with low nitrogen fertilizer.

The nitrification inhibition rate of soil for BNI-enabled wheat, which was announced in a press release on August 31, 2021 (see page 10), is about 30% in actual measurement. However, the research group has been developing a feasible target of 40% nitrification inhibition rate in order to achieve carbon neutrality by 2050.

In this study, we applied a new model based on LCA with corrections for BNI, and showed that the life-cycle GHG emissions can be reduced by 15.9% when BNI-enabled wheat with 40% nitrification inhibition rate is applied. We also estimated that the nitrogen use efficiency of wheat in this case would be improved by 16.7%, and the amount of fertilizer nitrogen applied could be reduced by 15.0%. On the other hand, BNI-enabled wheat has been shown to exhibit good nitrification inhibition in slightly acidic to neutral soils (pH 5.5-7.0). About 30% (about 72 million ha) of the world’s wheat production area (about 240 million ha) meets these conditions, and it was estimated that a 9.5% reduction in nitrogen fertilizer-derived greenhouse gases would be possible if BNI-enabled wheat with 40% nitrification inhibition were introduced.

The development of BNI-enabled wheat will contribute to the establishment of an agricultural system that combines high productivity with reduced environmental impact from agriculture, and is expected to have an effect on mitigating global warming.

The results of this research have been published in the online edition of the scientific journal *Environmental Science and Pollution Research* (September 1, 2021, Japan time).

JIRCAS TODAY

[2021 (The 15th) Japan International Award for Young Agricultural Researchers (Japan Award) and Commendation Ceremony]

The Japan International Award for Young Agricultural Researchers (Japan Award), which began in 2007, is organized and presented by the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan to honor young foreign researchers whose outstanding achievements promote research and development of agricultural, forestry, fishery and other related industries in developing regions.

Up to three young researchers under age 40 (as of January 1st, award year) who have shown (1) outstanding performance in research and development in agriculture, forestry, fisheries, or related industries in developing regions and

(2) outstanding achievements in research and development that will lead to future technological innovation in agriculture, forestry, fisheries or related industries in developing regions

are invited yearly to Japan to receive certificates of commendation from the Chairman of the Agriculture, Forestry and Fisheries Research Council.

To prevent the spread of coronavirus (COVID-19) infection, the 2021 Japan Award commendation ceremony was pre-recorded and streamed online on November 16 (Tuesday).

The 2021 (The 15th) Japan Award Winners (Honorific titles omitted):

Sahadev SHARMA (39 years old, Male, Indian)

Professional Affiliation: University of Malaya, Malaysia

Research Achievement: Mangrove forest blue carbon research for effective nature-based solutions to mitigate climate change in Asia Pacific region



Hala GAMAL ALI ALI EL DAOUS (30 years old, Female, Egyptian)

Professional Affiliation: Benha University, Egypt

Research Achievement: Establishment of a novel diagnostic test for Bovine leukaemia virus infection using direct filter PCR



James Seutra KABA (38 years old, Male, Ghanaian)

Professional Affiliation: Kwame Nkrumah University of Science and Technology, Ghana

Research Achievement: Nitrogen nutrition of cocoa (*Theobroma cacao* L.) in intercropping systems with gliricidia (*Gliricidia sepium* (Jacq.) Kunth ex Walp.)



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Information and Public Relations Office

1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, JAPAN

Phone: +81-29-838-6313 Fax: +81-29-838-6316

<https://www.jircas.go.jp/>



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