rice TODAY

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How green is your rice?

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When rice farmers and wildlife collide. In Cambodia, the critically endangered Bengal florican is threatened by the increasing commercial rice cultivation in Cambodia's Tonle Sap floodplain during the dry season. The cultivation of rice twice a year not only encroaches on the birds' breeding areas but the use of pesticides affects their food source.

By adhering to the Sustainable Rice Production (SRP) standard—which promotes reducing the use of agro-chemicals, protecting the environment, and conserving wildlife— both the Cambodian farmers and the Belgian florican benefit. See story on how the SRP in Cambodia is turning rice farming into an environment-friendly industry on page 16.

Photo by ©Nejib Ahmed (https://goo.gl/1vzj2X)

CONTENTS

rice TODAY Vol. 16, No. 4

About the cover

The Sustainable Rice Platform Standard and Performance Indicators for Sustainable Rice Cultivation uses environmental and socioeconomic benchmarks to maintain yields for farmers, reduce the environmental footprint of rice production, and meet consumer needs for safe and quality food. It is made up of 46 requirements for productivity, food safety, worker health, labor rights, and biodiversity that enable rice value chain actors to measure the sustainability of a rice system as well as monitor and reward progress. (Photo by Isagani Serrano, IRRI)

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International Rice Research Institute
DAPO Box 7777, Metro Manila, Philippines
Web: ricetoday.irri.org

Rice Today editorial
telephone: (+63-2) 580-5600 or (+63-2) 844-3351 to 53, ext 2725; fax: (+63-2) 580-5699 or (+63-2) 845-0606; email: info_ricetoday@irri.org

editor **Alaric Francis Santiaguel**
Africa editor **Savitri Mohapatra**
Latin America editor **Neil Palmer**
copy editor **Bill Hardy**
designer and production supervisor **Grant Leceta**
photo editor **Isagani Serrano**
printer **CGK formaprint**

RICE FACTS

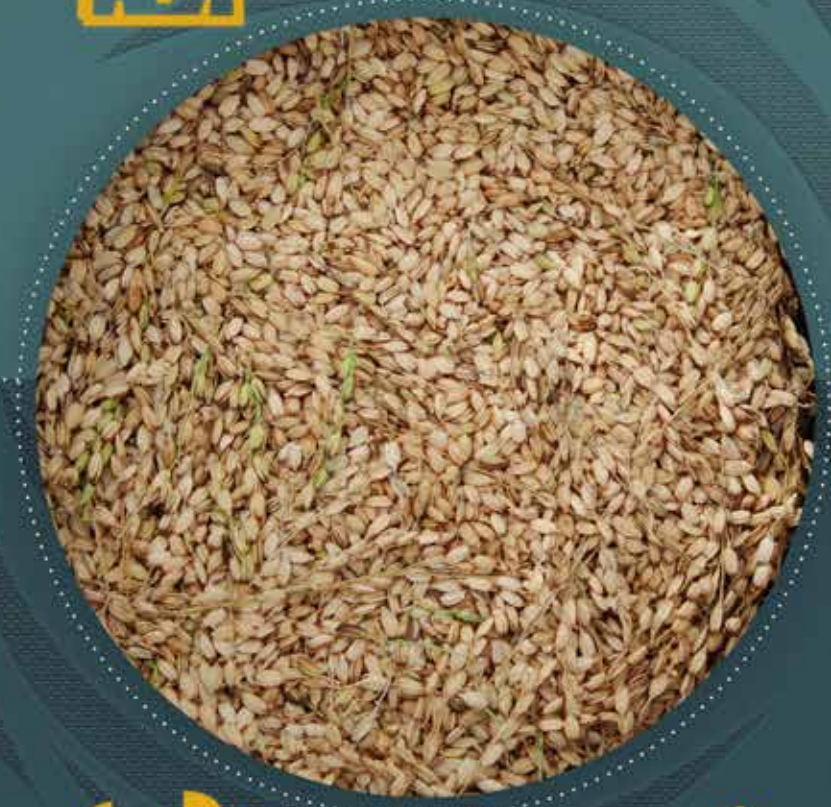
rice and food security

Rice provides livelihoods for over 1 billion people.

Rice is produced from 157 million hectares, mostly produced on 144 smallholder farms.

Rice production needs to increase by 25% over the next 25 years to meet global demand.

Rice is the daily staple for more than 3.5 billion people.



Rice uses 34-43% of the world's irrigation water for production.

Rice farmers are among the world's most vulnerable to adverse climate change impacts.

Rice is responsible for up to 10% of global methane emissions.

Rice fields represent 15% of the world's wetlands.

rice and environment

The importance of sustainable rice systems

by Bas **Bouman**

Rice is the world's most important staple food for more than half of the planet's population and will continue to be so in the coming decades. It provides up to a third of the calories in low- and middle-income countries.[1] With expected population and income growth, the global demand for rice will continue to increase from 480 million tons of milled rice in 2015-16 to 536 to 551 million tons in 2030.

Because rice is such an important food crop, it also has a sizable ecological footprint: it is annually harvested from 157 million hectares (8% of the world's crop land), uses 27 million tons of fertilizer (15% of the world total), receives 440-550 km^3 of irrigation water (34-43% of the world total), and accounts for 1.2% of all global greenhouse gas emissions. (See rice infographics on opposite page.)

Rice farming is also associated with poverty. About 900 million of the world's poor and undernourished people depend on rice as farmers, small millers, processors, traders, retailers, or consumers. Out of these, around 400 million are engaged in growing rice on 144 million smallholder farms.

With diminishing and threatened land, water, labor, and energy resources and the problems brought about by climate change, rice will have to be produced, processed, and marketed in more sustainable and environment-friendly ways. And, to help lift farmers and other supply-chain actors and consumers out of poverty, rice production and processing need to be profitable for its actors while the grain itself needs to remain affordable to consumers.

Hence, rice plays a crucial role in realizing the United Nations (UN) Sustainable Development Goal to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

Globalization increasingly affects the world's rice sector nationally and locally. Although the bulk of rice is still consumed domestically, the share of internationally traded rice increased from less than 4% before the mid-1990s to 7–8% by 2010. Other effects of globalization include the entry of the private sector into rice breeding, increasing interest in direct sourcing of rice by international food companies, expanding penetration of multinational input and service suppliers in national rice sectors, the increasing role of these companies as major providers of agronomic and management advice to farmers, and the formation of global multistakeholder platforms, such as the Sustainable Rice Platform (SRP), comprising the food industry, agri-businesses, academia, the public sector, and nongovernment organizations.

The SRP was created to improve the overall biophysical, environmental, and socio-economic sustainability of the global rice sector. Convened in 2011 by the UN Environment Programme and the International Rice Research Institute, it currently assembles 76 global, national, and local actors from academic, public, and private sectors along the whole rice value chain. It promotes resource efficiency and sustainability in the global rice sector through an alliance that links research, production, policymaking, trade, and consumption. The SRP pursues public policy development and voluntary market transformation initiatives to provide private, nonprofit, and public actors in the global rice sector with sustainable production standards and outreach mechanisms that contribute to a higher global supply of affordable rice, better livelihoods for rice producers, and a lower environmental impact of rice production.

[1] All data presented in this text are from the CGIAR Research Program on RICE, 2016. Available for download at https://goo.gl/c4a1BS).

In 2015, the SRP launched the world's first international standard for sustainable rice. It sets new and more efficient standards for rice cultivation that allow any rice system to be assessed for its sustainability via 46 requirements under eight broad themes: farm management, pre-planting, water use, nutrient management, pest management, harvest and postharvest, health and safety, and labor rights. Progress toward compliance can be measured through a set of 12 quantitative performance indicators. Together, the SRP standard and indicators offer an objective "working definition" of sustainability that can serve as a basis for monitoring and evaluation, policymaking, as well as a benchmark for supply chain assurance schemes. After two years of field testing by the SRP and its partners, the standard and indicators are being evaluated and the rollout of version 2 is being prepared.

On 3-5 October, at the United Nations Convention Centre (UNCC) in Bangkok, the SRP will hold the First Global Sustainable Rice Conference and Exhibition 2017. It will bring together its members and dialogue partners to review the experiences with the standard and indicators and discuss collaborative approaches and innovative solutions to the critical sustainability challenges facing the rice sector.

This special issue of *Rice Today* features the SRP and the sustainable rice standard and indicators, and showcases some of the experiences obtained by its members and partners in the field. It also presents several research-based technologies that can help farmers improve sustainability in various dimensions while contributing to food security and poverty alleviation. The contributors to this special issue hope that readers, especially the participants in the conference and exhibition, become excited about these developments in the ricer sector and join the efforts of the SRP! ■

Dr. Bouman is the director of the CGIAR Research Program on rice agri-food systems (RICE).

Finding the balance between the rice sector and the environment

by Wyn **Ellis**

How can we boost production on existing rice lands, protect the environment, mitigate climate change impacts, and safeguard smallholder livelihoods all at the same time?

In 2015, the SRP launched the world's first Standard for Sustainable Rice Cultivation together with a set of performance indicators to evaluate impact. The SRP and its members are now working toward market transformation through developing a private-sector assurance scheme as well as engaging at the policy level and via the international donor community to boost wide-scale adoption of climate-smart and sustainable best practices throughout rice value chains.

The SRP's goal is to minimize environmental impacts of rice production and consumption, mitigate climate change impacts, and enhance smallholder income.

Over the next 5 years, through an alliance that drives innovation and creates shared value, the SRP aims to encourage one million rice smallholders to adopt sustainable best practices in rice production that will improve their income while supporting a healthy environment.

The programs and operations of the SRP are delivered in collaboration with its members, with support from the Advisory Committee, Secretariat, and Working Groups.

The **Advisory Committee** provides oversight to the SRP. This body, composed of representatives from government, the private sector, and nongovernment organizations, advises on the strategy and annual working plans and ensures that the platform achieves its objectives.

Three **Working Groups** focus on implementation of programs: (1) Communications, Outreach, and Resource Mobilization; (2) Public Sector Engagement; and (3) Farmer Support, Performance Measurement, and Assurance. Member institutions may contribute to more than one working group. The groups work toward a mandate given by the Plenary and the Advisory Committee.

The **Secretariat** supports the Advisory Committee and the Working Groups and is responsible for operational management of the SRP's operations and administration.

Visit www.sustainablerice.org to obtain the latest updates on activities related to sustainable rice production and find useful resources. Membership application details are likewise available on the website. ■

Dr. Ellis is the coordinator of the SRP.

THE LINK BETWEEN RICE SUSTAINABILITY AND FOOD SECURITY

by James **Lomax**

Rice is fundamental to people and the planet. It is the staple food for some 4 billion people worldwide and for 70% of the world's 900 million poor. The rice sector is a significant contributor to global food security. It represents 19% of global per capita caloric intake and 27% of the calorie intake in low- and middle-income countries.

However, the United Nations Environment Programme's (UN Environment) focus in the rice sector is borne not only from its importance in feeding a growing and economically developing population but also from its relationship with the environment.

The rice sector affects the environment in ways that will be explained below. However, it is the potential of the sector to be a force for good in sustainable natural resource management and landscape management that remains to be exploited.

If change is not effected by those that make up the sector (smallholder farmers, millers, input-providers, traders, consumers, and policymakers), its role as a fundamental contributor to food security faces considerable threats from the excessive use, unsustainable cultivation practices, and climate change.

Vietnamese farmers who participated in the piloting of the SRP standard reported earning higher incomes, lower production costs, better rice quality, safer working conditions, and a cleaner environment.In the next two years, the SRP program will target 4,000 farmers in the Mekong Delta for training in the new rice farming practices. (Photo: IRRI)

Rice and the environment

How does rice production affect the planet? Broadly, we could separate this into three interrelated effects.

First, let's look at natural resource use. Rice is a significant user of natural resources. It is grown on 157 million hectares of land in a world where arable land is becoming more scarce and degraded. It is also the world's thirstiest crop. Prevailing rice production receives around a third of the world's irrigation water, often in parts of the world that experience extreme water stress.

Second, rice production contributes to loss of biodiversity through agricultural pollution. Although rice fields account for 15% of the world's wetlands and irrigated rice fields are the richest agroecosystems for water birds,[1] this biodiversity is under threat.

The availability and affordability of inputs such as pesticides and fertilizers have undoubtedly played a significant role in the planet's ability to feed itself and in the Green Revolution of the second half of the 20th century. When used appropriately, agricultural inputs complement agroecological cultivation techniques and can contribute to higher profitability and productivity.

However, there is evidence that the inappropriate application of fertilizer releases nitrates into the environment and pollutes water ways that affect marine biodiversity and water quality. Overreliance on pesticides and fertilizers and their inappropriate use are also increasing the resilience of pests, causing pest infestations in some areas, and affecting farm biodiversity and, in some cases, farmer well-being.

Third, rice production is both affected by and contributes to climate change. Rice production systems are becoming more vulnerable as higher temperatures lead to lower rice yields as a result of shorter growing periods. In some cases, 8–10% declines in yield occur for every 1 degree Celsius increase in night temperature associated with global warming.

[1] van der Weijden W, Terwan P, Guldemond A. 2010. Farmland Birds Across the World. Lynx Edicions, Barcelona, Spain.

This is compounded by more extreme weather causing erosion and lodging on the one hand and water scarcity on the other. Also, rising sea levels caused by climate change threaten coastal and deltaic rice production areas in Asia, such as those in Bangladesh and the Mekong River Delta.[2] As much as 7% of Vietnam's rice-producing land could be affected by a 1-meter rise in sea level.

The Intergovernmental Panel on Climate Change, which assesses the potential environmental and socioeconomic impacts of climate change, warns that productivity will decline up to 20% by 2050 compared with 2000. This could potentially exacerbate rural poverty in parts of Asia as a result of the effects on the rice crop and could cause increases in food prices in the long term, thus increasing food insecurity.

Planet-friendly platform

To help solve these problems and drive the adoption of climate-smart, sustainable best practices among rice smallholders in developing countries, UN Environment joined hands with the International Rice Research Institute in 2011 to create a public-private partnership with governments, researchers, and private-sector stakeholders called the Sustainable Rice Platform (SRP).

In fact, the Platform's evolution began back in 2009 when UN Environment started to examine its possible role in sustainable commodity production. Crucially, although all the impact in the rice sector is at the farm and landscape level, more than 90% of rice is produced and consumed in the same country, with another 4% traded from Asia to Africa. Therefore, the successful model for high-value commodities such as cocoa, coffee, and tea, for which there is a predominant south-north trade flow pulling demand for sustainable products, would not work in the same way for the rice sector.

What was needed was an innovative approach—one that would address not only the need for a holistic response at the farm level but also one that would overcome the barriers to the adoption of best practices. To examine the need for a holistic response at the farm level, the Standard for Sustainable Rice Cultivation V1.0 was launched in 2015.

Through a multi-stakeholder process in 2014 and 2015, this standard tackles specific needs and challenges of rice farmers, including water efficiency and climate change mitigation techniques such as alternate wetting and drying, along with integrated pest and nutrient management. A set of performance indicators was also developed so that impact could be measured during the cropping season.

This standard has empowered stakeholders to make public commitments, such as Mars Inc., which committed to 100% sustainable sourcing of its rice by 2020 using SRP tools and methodologies. (See *From crop production to market: Improving the livelihood of Pakistan's basmati rice farmers* on pages 14-16 of *Rice Today* Vol. 15, No. 2.) It also attracted interest from many other rice stakeholders and companies from rice-producing countries that have started to pilot the tools and methodologies.

However, simply taking a farm-level approach will not create the transformation needed. This is why UN Environment will work with the Food and Agriculture Organization of the UN and other key stakeholders within the SRP to examine the potential of rice farmers to become long-term guardians of the rice sector and its sustainability—through incentives provided within the supply chain, consumer demands, or public policy development. ■

Mr. Lomax is the Sustainable Food Systems and Agriculture Programme Officer in UN Environment's Division of Technology, Industry, and Economics.

UN Environment will work with key stakeholders within the SRP to examine the potential of rice farmers to become long-term guardians of the rice sector and its sustainability. (Photo: Isagani Serrano, IRRI)

[2] Wassmann R, Jagadish SVK, Sumfleth K, Pathak H, Howell G, Ismail A, Serraj R, Redoña E, Singh RK, Heuer S. 2009. Regional vulnerability of climate change impacts on Asian rice production and scope for adaptation. Advances in Agronomy 102:91–133.

A green standard brings a new era of sustainability for the global rice sector

The Sustainable Rice Platform is a promising tool for strengthening Southeast Asia's rice sector by promoting sustainable rice value chains globally.

by Astari Widya **Dharma**

Rice is an important source of food for more than half of the global population and is therefore of extreme public and political importance. Its production provides vital food security and employment to millions of some of the world's poorest people. However, in many countries, the rice value chain lacks appropriate production, processing,

An SRP rice field in Thailand is being audited by an independent third party to determine the farmer's compliance with the standard. Some buyers may require such an assessment although adoption is monitored mainly using the SRP verification system. (Photo by ©Astari Dharma, GIZ BRIA)

and marketing structures, and is restrained by inefficient and environmentally hazardous use of resources.

Global consumers are increasingly aware of sustainable rice production, food safety, and climate change. These issues affect most parts of the agricultural sector, including the rice sector. Promoting good agricultural practices and proper technologies and facilitating better access to high-quality farm inputs are vital to increasing the productivity and livelihood of farmers.

Promoting sustainable rice value chains

In helping to strengthen Southeast Asia's rice sector, the German Federal Ministry for Economic Cooperation and Development (BMZ), in cooperation with private agricultural companies, launched the Better Rice Initiative Asia (BRIA), a public-private partnership project, to improve smallholder farmers' livelihoods and food security by improving rice value chains in Southeast Asia. The German International Cooperation Agency, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), was appointed as the implementer for BRIA.

This regional project began in 2013, and is being implemented in Indonesia, the Philippines, Thailand, and Vietnam. It identifies problems and seeks solutions to increase farmers' livelihoods by promoting sustainable rice value chains globally, and achieving food security. BRIA focuses on farmers' capacity building, multi-stakeholder partnerships, and providing policy recommendations for the scaling up of BRIA's interventions.

An Indonesian farmer from Sulawesi inspects AWD tubes used in alternate wetting and drying technique for better water management and lower methane gas emission. AWD is one of the technologies included in the SRP standard. (Photo: IRRC/IRRI)

A sustainable philosophy and standard

BRIA actively supported the Sustainable Rice Platform (SRP) and tests its SRP standard with local government authorities and private partners. The BRIA philosophy states that the SRP standard can be used as a framework to ensure the sustainable production and supply chain of products. It supports good-quality and safe food for a wide range of consumers, and it is also used as a monitoring tool to assess the sustainability of BRIA farmers' farming practices. SRP members and users of the standard agree on the importance of a collaborative approach toward sustainability.

The standard has, so far, fulfilled its promise as a helpful tool for assessing the sustainability performance of rice farmers. Moreover, it demonstrated its potential value when used in conjunction with the performance indicators as an impact monitoring tool to assess risk and identify areas for improvement.

Filling the gap

BRIA has taken several approaches in the adoption of the SRP tool.

In all four of its project countries, BRIA seeks to support farmers by developing training materials on good and sustainable agricultural practices (GAP), referring to local policies and recommendations in support of local research institutes and government experts on rice. The SRP is seen as complementary to existing GAP standards or recommended practices in the rice sector. In 2016, all GAP training materials were assessed on the basis of SRP standard topics. Up to 70–80% of the topics within the SRP standard have been covered in the BRIA training materials.

When the farmers have understood the SRP standard thoroughly and are able to conduct self-assessments, it will be easier for them to connect with other stakeholders, especially buyers. The ideal arrangement would be where market linkages exist and farmers receive an economic benefit from better quality products.

The standard can be used as a benchmark tool for farmer compliance and/or a benchmark for farmers' best practice recommendations or other rice farming standards. Eventually, the standard can be adapted into the current system to improve the recommended practices and the national standard. With the revised recommended practices that have been added to fill the gaps in the SRP standard, farmers will be trained in farming practices and in devising a framework for organizing farmer groups.

Apart from adoption in a group management structure, farmers are capacitated to conduct peer reviews as an internal control system. When the farmers have understood the standard thoroughly, and are able to conduct self-assessments, it will be easier for farmers to connect with other stakeholders, especially buyers. The ideal arrangement would be where market linkages exist and farmers receive an economic benefit from better quality products. Adoption focuses mainly on the verification system although some buyers require a third-party audit for the verification and credibility of the compliance.

GIZ carries SRP tools into the fields

BRIA Thailand, BRIA Philippines, BRIA Vietnam, and BRIA Indonesia have been actively participating in the SRP pilot testing.

In Vietnam, BRIA and the Institute of Policy and Strategy for Agriculture and Rural Development conducted a benchmark study among Rice Viet GAP, Global GAP standard, and SRP standard. It concluded that the SRP standard has more potential for wider adoption in Vietnam and could bring better recognition in international trade. It is hoped that this recommendation will be carried further by the Ministry of Agriculture and Rural Development. (See *The SRP in Vietnam* on page 13.)

In Indonesia, an assessment survey was carried out by a local university in the third quarter of 2016 in North Sumatra Province. According to this self-evaluation, BRIA Indonesia farmers have complied, with an average score of almost 69% against the standard. The result of this study will later form a policy recommendation to the Indonesian Ministry of Agriculture for possible adoption of the SRP standard.

In the Philippines, 68 farmers have piloted the SRP standard in Iloilo Province. The International Rice Research Institute conducted a farmer survey in January 2017 that revealed an average of 65–70% compliance toward the SRP standard. The result will be used as a policy recommendation to the Department of Agriculture for potential use of the standard as a monitoring tool for sustainable rice farming practices in the Philippines. (See *The SRP in the Philippines* on page 17.)

In Thailand, the pilot testing covers an assessment of the applicability of the standard, farmer training, establishment of an internal management system as a farmer-level assurance system. (See *The SRP in Thailand* on page 15.) ■

Ms. Dharma is the regional project coordinator at GIZ BRIA.

Field agronomists interviewing farmers in Iloilo, Philippines to establish benchmark information on their current farm practices. (Photo by Jaime Gallentes, GIZ)

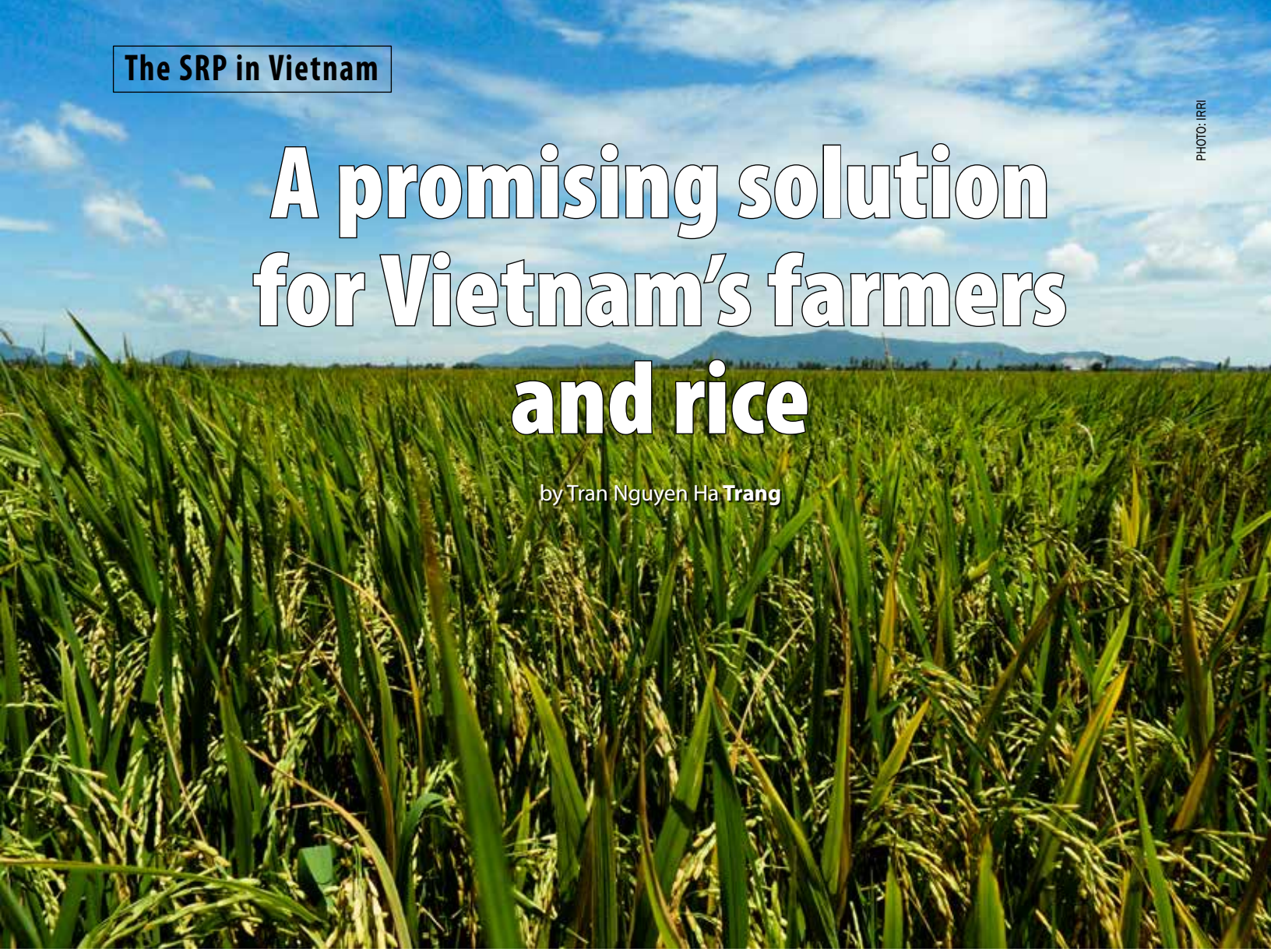


PHOTO: IRRI

A promising solution for Vietnam's farmers and rice

by Tran Nguyen Ha **Trang**

Rice is the most important crop in Vietnam because it ensures national food security. Although Vietnamese rice has competitive advantages in the world market, the grain it produces often fails to meet strict quality standards.

From 2008 to 2013, China and Japan, two major buyers of Vietnamese rice, stopped importing the product after discovering it contained significant amounts of pesticide residue. In the first quarter of 2016, the United States rejected 1,700 tons of rice from Vietnam after detecting high levels of pesticide residue in shipments of the product. This was followed by a 33% decline in rice exports to the U.S. in that year.

Improving its rice production will help the country further expand its market share, increase the rice sector's profitability sustainably, and improve farmer livelihoods.

Creating a sustainable brand

The Loc Troi Group, a leading provider of agricultural services and products in Vietnam, has been organizing annual rice production on hundreds of thousands of hectares in Vietnam. The company invests in agricultural inputs, transfers technology to smallholder farmers, and buys and processes rice for export under the corporate brand Hat Ngoc Troi. It believes that sustainable agricultural practices on-farm and throughout its rice-production value chain, including reducing greenhouse gas emissions and mitigating the effects of climate change, are key factors in building its rice brand.

To help it meet its goals, the Loc Troi Group joined the Sustainable Rice Platform (SRP) in 2015. The group also partnered with the International Finance Corporation (IFC), a member of the World Bank Group, to provide financial support to help the Loc Troi Group conform to agricultural standards and practices developed by the SRP.

Since becoming a member of the SRP, the company conducted SRP standard pilot testing with 150 farmers in the Mekong Delta—the country's "rice bowl"—during the 2016 summer-autumn and 2016-17 winter-spring seasons. The pilot testing produced important results, particularly on the use of pesticides.

"One of the significant outcomes from this is the transformation of farmers' awareness of sustainable

production," said Huynh Van Thon, chairman of the Loc Troi Group. "Images of agricultural waste bins, farmers wearing personal protective equipment when applying pesticides, and warning boards after spraying became familiar sights to farmers. Before the pilot testing, we often saw empty pesticide bottles and packaging along canals and rivers. Now, after the implementation of the SRP for only two cropping seasons, rice fields are impressively clean throughout the SRP sites."

Healthy awareness

After his training, Mr. Nhat, an SRP farmer in Vinh Binh in An Giang Province, applied the new practices to his usual tasks, such as land preparation, seeding, and fertilizer and chemical application. He also recorded his farming activities in a diary under the guidance of agricultural engineers.

"Protecting my health and protecting the environment for the next generation are two of the most important changes for me," Mr. Nhat told an IFC representative. "For example, when I spray pesticide, I need to follow the dosage compliance and wear personal protective equipment, including masks, goggles, gloves, and boots. After I am finished, I must keep a warning sign on my farm. In the past, we used to simply hang the protective equipment for chemical application in the house. Now, we lock it in a designated cabinet."

Healthy profits

Implementation of the SRP standard also helped farmers increase their profit from rice cultivation.

According to reports of the Loc Troi Group on each pilot testing from the two seasons, this helped 150 farmers reduce their pesticide input by 25%, resulting in 17% higher profits and 10% lower production costs compared with non-SRP farmers. These results confirm the effects that the SRP brings to smallholder farmers, according to James Lomax, chairman of the SRP.

"The successful implementation of SRP criteria in particular and agricultural safety standards in general will not only benefit farmers, improve incomes, and protect the environment through plant protection chemical management, but also bring opportunities to strengthen the rice brand for Vietnamese enterprises," Mr. Lomax said.

Guardians of the environment

Currently, there are no standards and certifications related to greenhouse gas emissions or climate change in the rice sector in Vietnam.

Under the SRP standard, farmers are required to adopt certain practices in relation to greenhouse gas emissions. These include not burning rice straw and applying the alternate wetting and drying (AWD) technique for water use. These are documented in the farming diaries. SRP experts will calculate the amount of greenhouse gas emissions for each farmer's field as part of the SRP performance scoring system. This allows the assessment of the impact of agricultural production on the environment and climate change. Through this, farmers could see the importance in protecting the environment and protecting the atmosphere as they practice sustainable rice cultivation.

High expectations

By the end of 2018, it is expected that 4,000 farmers will be applying the SRP standard in the production areas of the Loc Troi Group.

Although the quality of Vietnamese rice is still considered to be low, the implementation of the SRP as well as the bio-organic agriculture of the Loc Troi Group is expected to bring positive changes in making the country's rice products safe and its agriculture sustainable.

"I strongly believe that, when the Vietnam rice brand gets stronger, the negotiations for higher rice prices will succeed," said Mr. Nhat. "And, our lives will improve as well." ■

Ms. Trang is a coordinator for international projects relating to agriculture at the Loc Troi Group.

"Protecting my health and protecting the environment for the next generation are two of the most important changes for me," Mr. Nhat, a rice farmer in An Giang Province, said after attending an SRP training. (Photos: Loc Troi Group)

A verified sustainable rice paddy harvested from an SRP site in Ubon Ratchathani Province. (Photo by ©Chatthep Chanyam, GIZ BRIA Thailand)

Better grain quality, higher incomes, lower production costs, and increased productivity

by Astari Widya **Dharma**

Thailand's Rice Department, Better Rice Initiative Asia (BRIA) Thailand, OLAM International, and Bayer Thai Co. Ltd. initiated pilot testing for the SRP standard with farmer groups in Ubon Ratchathani Province in the northeast of the country. During pilot testing, farmers received benefits, including free training from experts, helping them to produce more sustainable rice, which will create a massive impact within the region. Moreover, the paddies have better grain quality since the farmers received close advisory support from the experts, including facilitating the organization of a harvesting plan with certain service providers for harvesting.

The program urged farmers to apply a crop calendar for better planning of all farm activities and cost of production in the following years. Four hundred tons of SRP-verified sustainable rice have been harvested from 71 farmers who have been verified as "working toward sustainability" based on the SRP's Communication and Assurance Guidelines.

According to this independent third-party assessment, the farmers' SRP Sustainable Rice Cultivation Standard compliance levels averaged 82%.

From the pilot testing conducted, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has seen various benefits that the farmers could attain by adopting the SRP standard. Farmers could gain at least 20% higher incomes as a result of lower production costs, increased productivity, and improvements in product safety and quality.

Additionally, this will help farmers improve market linkages and measure various impacts, thus allowing farmers to assess the advantages of additional incentives. Sustainable practices also include green farming practices that could reduce greenhouse gas emissions in rice production. Given these potential benefits, GIZ will continue to promote adoption of the sustainable standard widely in its global activities. ■

Ms. Dharma is the regional project coordinator at GIZ BRIA.

PHOTO: WCS, CAMBODIA

Leveling the field for farmers, rice, and endangered wildlife

by Simon **Mahood**

Why should a conservation organization care about rice? That's what many people might have asked the Wildlife Conservation Society (WCS) before its Cambodia program embarked on the country's first Sustainable Rice Platform (SRP) pilot.

Rice is Cambodia's most important crop. It is grown for subsistence and for sale, domestically and for export. It matters more to the people of Cambodia than any other crop; so, if you want to work with the people of Cambodia, then you need to work with rice. Conservationists need to work with people. It is the actions of humans that threaten other species, and the actions of humans that can protect and nurture other species.

This was the lesson from WCS and our local partner Sansom Mlup Prey's Ibis Rice™ scheme (www.ibisrice.com). Ibis Rice™ rewards farmers in Cambodia's remote forested north for protecting forests and threatened ibis species, Cambodia's national bird. Ibis Rice™ has gone from being an NGO project to a successful boutique product. The SRP is not boutique. It is rice grown at scale in a sustainable way; but WCS's experience with Ibis Rice™ was enough to make us interested in the SRP.

There has been considerable change in Cambodia's rice sector over the past 20 years. Rice cultivation methods have changed. In the floodplains of the Mekong Delta and Tonle Sap, the most striking change has been the almost complete abandonment of deepwater rice cultivation and the rapid spread of irrigated dry-season rice. Irrigated dry-season rice is now grown extensively in the middle and inner floodplains. Large earth dams are constructed to trap the receding floodwater, from which irrigation channels bring water to surrounding fields. Chemical fertilizers and pesticides are increasingly used.

These changes have inevitably affected wildlife. WCS has been working with the Ministry of Environment for nearly 20 years to prevent the extinction of the Bengal florican, a critically endangered goose-sized grassland bird. The Bengal florican breeds on fallow and abandoned rice fields and grasslands and its population has declined by at least 50% over the past 10 years. There are now less than 500 left in Cambodia, mostly in Kampong Thom Province. Because of the interaction between the Bengal florican and rice farmers, WCS chose to do an SRP pilot in an area that the birds use for feeding when migrating.

The *Phka Romdoul* rice grown by the farmers at our pilot site was bought, milled, and exported by the Battambang Rice Investment Co., Ltd. to Mars Inc, a company that has shown global leadership in championing the SRP. During the first year of the pilot, only 40 farmers received seed of the correct variety and quality. But, in the second year, the number of farmers increased to nearly 330 cultivating a total of nearly 800 hectares. The farmers received agronomy support throughout, and those who took part in the first year of the pilot had their fields leveled prior to sowing in the second year. Although not an obvious management intervention for a conservation organization, leveling of fields means that farmers can control water level efficiently and consequently reduce the need for intensive use of herbicides. The farmers benefit from higher productivity while the Bengal floricans benefit from a healthier environment. The farmers also agreed stop killing the birds that are foraging for food on their farms. In the past, locals used to kill the birds on their farms thus contributing to the decline in its population.

We have developed a seed production group among the farmers to increase the sustainability of the project. Over the next few years, we hope to increase the number of SRP farmers that we are working with in Kampong Thom Province and help the farmers manage the field margins and cropping systems to create a safe haven for the Bengal florican.

A better question now might be: Why wouldn't a conservation organization care about rice? ■

Mr. Mahood is a senior technical advisor at WCS Cambodia.

The SRP in the Philippines

Pilot testing of the Sustainable Rice Platform (SRP) standard in the province of Iloilo has shown Filipino farmers' strengths in managing their farms in a sustainable manner as well as opportunities to improve their current practices to achieve sustainable rice cultivation.

In the 2016 wet season, SRP-trained agricultural extension workers, farmer technicians, Better Rice Initiative Asia (BRIA) coordinators, and staff from the Department of Agriculture-Regional Field Office in Region 6 (DA-RFO6) monitored the participating farmers in four municipalities from April to September. The monitoring gauges whether farmers' practices are sustainable based on the SRP standard.

On average, the farmers scored 64 to 76 sustainability points out of the 90 points required for them to earn sustainability status. They had the lowest scores in food safety and labor rights. The results indicate that the farmers could work toward sustainable rice cultivation if given the appropriate support such as tailored programs that build on what they currently have to narrow these gaps.

The pilot testing also covers the 2017 wet season and will end in October. The sustainability scores in both seasons will then be compared and evaluated based on the thematic areas for which the farmers have improved and for which they require reinforcements.

However, the farmers are already seeing the benefits of the SRP.

"The SRP enlightens us on the value of record keeping," said the members of the Zarraga Integrated Diversified Organic Farmers Association. Keeping track of various management details (e.g., rice varieties used, yield, amount of fertilizer and pesticide, costs, profitability) is part of the standard. "It also widens our understanding of the importance of protecting the environment through the efficient use of water and organic fertilizer."

Members of the Banga Dawis Pototan Farmers Association added that, through the SRP, they learned that the proper use of physical protective equipment and minimizing the use of pesticide can lead to better health. "We now know that we are eating safe rice," one member said.

Furthermore, farmers who are considering adopting the SRP standard have already set their expectations of obtaining higher yield and a higher market price for their produce.

The DA-RFO6 has acknowledged the importance of the SRP in its current work and has considered the SRP standard as a tool for monitoring and evaluating the outcomes of their training, as well as tracking the practices of farmers through their records.

Supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) under the framework of BRIA, the pilot testing is implemented by DA-RFO6 and the International Rice Research Institute in cooperation with the municipalities of Zarraga, Pototan, Leganes, and San Miguel. ■

Mr. Gallentes is the senior coordinator for GIZ Agri-DPP Projects.

"We now know that we are eating safe rice"

by Jaime **Gallentes**

PHOTO BY ISAGANI SERRANO, IRRI

Smart fertilizer management and the quest for sustainable rice production

by Pauline **Chivenge** and Sheetal **Sharma**

Specific fertilizer recommendations in smallholder rice farming systems could increase crop production while reducing pollution and greenhouse gas emissions.

Rice production relies on the use of synthetic fertilizers, especially nitrogen, in order to meet the challenge of rising demand for the commodity driven by population growth. However, the nutrient needs of rice crops are not constant and can vary with fields, seasons, and years because of differences in crop-growing conditions and management. Consequently, the proper management of nutrients for rice production needs to be adjusted to suit field and crop requirements.

Furthermore, the application of external nutrients constitutes the second most expensive rice production input, after labor. As a result, nutrient management is an important component for sustainable rice production while protecting the environment.

Too much of a good thing

The Green Revolution in the mid-20th century resulted in increased crop yields, including rice, in the developing world. Much of this was due to a combination of the introduction of improved varieties and more reliance on the use of synthetic fertilizers, herbicides, and pesticides. However, although the Green Revolution was undoubtedly beneficial in improving food security, it was also associated with a dramatic increase in pollution due to the high use of agricultural chemicals.

Fertilizer recommendations in smallholder rice farming systems are often given as blanket recommendations, but this can lead to the overuse of fertilizers and inefficient use of nutrients. This created a need to find approaches to increase crop production while reducing pollution.

Location-specific information

Soil testing has been promoted to estimate location-specific fertilizer requirements based on the measurement of soil nutrient pools for a field or location. Soil-test methods attempt to measure the proportions of nutrients available for crops, but the amount measured may differ across soils with contrasting properties. Additionally, different tests for one nutrient often provide different results that can be expressed in a variety of ways.

Therefore, soil-test methods need to be calibrated to be used in a specific region. Soil testing requires rapid sequential sampling of soil, laboratory analysis, and timely deployment of a fertilizer recommendation with training for farmers before crop establishment. The effective implementation across hundreds of thousands of fields has been constrained by the high costs involved in sampling and analysis.

In developed countries, precision nutrient management is done using sophisticated technology to monitor variations in nutrient levels within large fields and across seasons. But, this is not applicable for small fields in Asia and Africa.

The site-specific nutrient management (SSNM) approach was developed in the 1990s to enable rice farmers to apply fertilizers and efficiently meet varying nutrient requirements of plants, thereby reducing fertilizer misuse associated with fertilizer subsidy.

The approach is used to calculate field-specific requirements for fertilizer nitrogen, phosphorus, and potassium for cereal crops based on scientific principles with the aim to increase nutrient-use efficiency. SSNM has improved rice yields compared with the farmers' practice often based on blanket recommendations.

Timing is everything

The SSNM approach, however, does not aim to increase or reduce the amount of fertilizer used. The increase in grain yield with lower amounts of fertilizer has been associated with better timing of application, particularly for nitrogen. Farmers apply a greater proportion of the nitrogen fertilizer in the early stages of the crop, causing higher vigor during early growth, which does not translate into higher grain yield at maturity.

In recent years, SSNM has been identified as one of the options for sustainable intensification of rice production in Asia and as a climate-smart technology for increasing resource-use efficiency while reducing greenhouse gas emissions and nutrient runoff into water sources.

The SSNM approach relies heavily on information generated from nutrient omission plot trials that are used to estimate fertilizer requirements for major nutrients (nitrogen, phosphorus, and potassium). Briefly, nutrient omission plots are small field trials in which adequate nutrients—except the nutrient of interest—are applied to a plot in order to estimate the supply of the omitted nutrient from indigenous sources such as soil, crop residues, irrigation water, biological nitrogen fixation, and atmospheric deposition. This is used to calculate the amount of fertilizer required to achieve a given yield target.

Phosphorus and potassium are generally applied at sowing or transplanting while nitrogen is applied at different crop stages. Thirty percent of the nitrogen is applied at transplanting and the rest is equally split at critical rice growth stages: active tillering and panicle initiation. Alternatively, the nitrogen splits can be determined using leaf color charts.

Rice production in Asia is largely done by smallholder farmers who often lack access to information. For sustainability, there is a need to develop tools that are accessible to farmers. Using the principles of SSNM, an information and communication technology decision support tool, *Nutrient Manager*, was developed to give field-specific fertilizer recommendations for smallholder farmers.

Nutrient Manager targets irrigated and rainfed lowland rice farmers with the aim to increase productivity and net income by USD 100 per hectare per season at the farm level. The tool has been widely tested and used in the Philippines, India, Bangladesh, and Vietnam, and has led to an increase in farm productivity and profitability. The tool was later developed into the *Rice Crop Manager* in the Philippines and India, which give climate-informed agro-advisory services to farmers, including the selection of suitable varieties. (See *An app tailor-made for India's rice farmers* on page 20.)

Although the tool has effectively improved productivity in 80% of the locations where it has been tried, there is room to expand the fertilizer recommendations for a wider set of conditions. Additionally, dissemination of the tool needs to be boosted to give more rice farmers access to smarter and more sustainable fertilizer management. ■

PHOTO: IRRI

Dr. Chivenge is a soils and biogeochemistry expert at the International Rice Research Institute (IRRI). Dr. Sharma leads IRRI's research on the design, evaluation, and dissemination of soil and nutrient management technologies for the rice-based systems of South Asia.

An app tailor-made for India's rice farmers

by Preeti **Bharti**, Priyanka **Anand**, Amit **Mishra**, and Sheetal **Sharma**

Given the wide variability of farms across India, the Rice Crop Manager (RCM) is providing management recommendations tailored to each farmer's field.

In Odisha, rice is synonymous with food. Out of the total arable land area of 5.8 million hectares, rice is grown on 4.5 million ha (around 77%) of both rainfed and irrigated areas. However, average productivity is only 1.8 tons/ha, which is below the national average of 2.4 t/ha. The major constraints in rice production in the state are flood, drought, and salinity, along with poor crop management practices.

Further, because of the lack of awareness of better crop management practices, farmers continue to use traditional farming practices passed on from generation to generation. This has resulted in improper use of fertilizers and pesticides that, in turn, increased the cost of cultivation but with low productivity and degradation of soil fertility.

Farm-level technology

In the 1990s, the International Rice Research Institute (IRRI), in collaboration with partners across Asia, developed the site-specific nutrient management (SSNM) approach. SSNM gives rice farmers guidelines for applying the right amount of essential nutrients for their crops at the right time. Compared with existing fertilizer practices, SSNM-based fertilizer recommendations for rice have been proven to increase yield and net income of farmers as well as provide positive impacts on the environment.[1]

Using the principles of SSNM, IRRI developed *Rice Crop Manager* (RCM), an application that provides farmers with crop management recommendations tailored to their field and rice-growing conditions through the internet, toll-free numbers (already available in the Philippines), and text messages (soon to be launched in India). In addition to nutrients, RCM addresses other constraints that limit rice yield and farmers' profit. These constraints can vary across areas, growing conditions, varieties, and climate scenarios.

RCM in Odisha

RCM was introduced in Odisha in 2013 under the Cereal Systems Initiative for South Asia (CSISA) project. It was developed, adapted, evaluated, and verified in partnership with the National Rice Research Institute and Odisha University of Agriculture and Technology.

RCM was identified as an important tool for increasing the profitability of farmers through improved nutrient-use efficiency and better crop management. When RCM was tested in farmers' fields, it produced about 1 t/ha more in rice yield than with traditional fertilizer application. In terms of income, there was an increase of USD 188 per ha per season.

In 2015, IRRI and the government of Odisha signed a memorandum of understanding to increase the productivity of rice-based cropping systems and enhance farmers' income in the state through the implementation of the project *Increasing Productivity of Rice-based Cropping Systems and Farmers' Income in Odisha*.

One of the aims of a subproject is to increase the productivity and profitability of rice farming throughout the state's rice-growing areas using RCM, train various stakeholders in using ICT-based tools, and expand the capabilities of RCM for irrigated and rainfed environments to include in-season corrections.

More than a thousand extension workers of the state's Department of Agriculture in seven districts have been trained in using the RCM application. They are providing RCM recommendations to farmers at their doorstep and encouraging them to follow the advisory throughout the season. Many nongovernment organizations (NGOs) with agricultural and livelihood mandates have also partnered with IRRI and are working to disseminate RCM recommendations among farmers.

"I applied fertilizers as per the RCM recommendation on half of my land and on the other half I applied fertilizers as per my usual practice," said Mr. Kartik Samal, a farmer from Bhadrak District. "In the RCM plot, the yield was higher by 1.2 tons and there was a cost saving of about USD 18 per ha because fewer fertilizers were applied."

Mr. Chandra Swain, a farmer from Puri District, also benefited from RCM. "Earlier, I used to apply split doses of fertilizer by guessing the crop stage," he said. "But the RCM recommendation guides me with the correct time for topdressings."

Approximately 44,000 farmers have received RCM recommendations for their rice crop since 2016.

RCM *kendras*

Under the project, RCM *kendras* (centers) are being established at block agricultural offices across the state to provide one-stop

RCM centers are strategically located near farming communities across Odisha to provide accessible information on nutrient management. (Photo CSISA)

[1] Pampolino MF, Laureles EV, Gines HC, Buresh RJ. 2008. Soil carbon and nitrogen changes in long-term continuous lowland rice cropping. *Soil Science Society of America Journal* 72:798–807.

information hubs for nearby farming communities. These *kendras* are equipped with ICT devices used by trained extension staff of the DoA to provide RCM recommendations to the farmers. Efforts are being made to popularize these *kendras* among farming communities and encourage farmers to visit them before the start of each cropping season to receive personalized recommendations for their rice crop.

Beyond rice

In Bihar and eastern Uttar Pradesh, farmers generally follow a rice-wheat or rice-maize cropping system. In view of these cropping systems, RCM was modified to create the *Crop Manager for Rice-Based Systems* (CMRS) under CSISA. IRRI developed CMRS in collaboration with Bihar Agricultural University, Rajendra Agricultural University, Indian Council of Agricultural Research-Research Complex for Eastern Region, and Banaras Hindu University.

Endorsed and released by the union agriculture minister for Bihar farmers in 2016, CMRS is being disseminated through Krishi Vigyan Kendras (KVK), NGOs, and private service providers. IRRI is responsible for training KVK scientists, NGOs, and service providers.

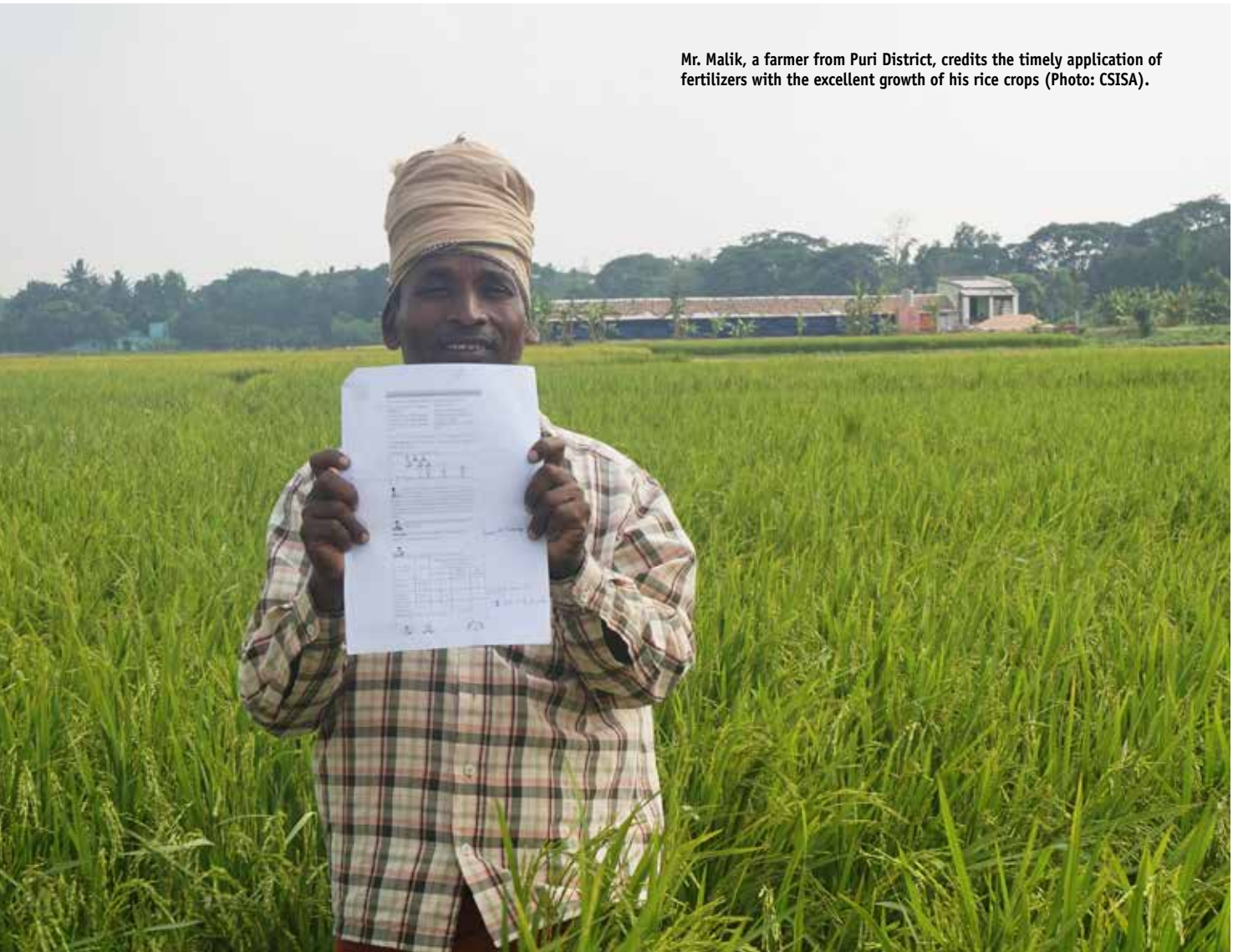
To date, thousands of CMRS recommendations have been generated and provided to the farmers.

The way forward

RCM is a work in progress and is continuously undergoing refinements and upgrading to make it even more farmer-friendly. IRRI is working with weather forecasting agencies to include weather-based advisories to help farmers receive real-time information on crop and nutrient management based on local weather conditions. The effects of this intervention are expected to occur in the next few cropping seasons.

Considering the wide variability of farms across India, the "one size fits all" approach is not an appropriate strategy for change. By providing farmers with personalized recommendations, this could help them make better decisions that, in turn, will lead to improved fertilizer use, balanced nutrient application, and higher agronomic efficiency. ■

Dr. Sharma leads IRRI's soil research in South Asia. Dr. Mishra leads IRRI's soil science team in India. Ms. Bharti manages training and communication of IRRI-Odisha projects. Ms. Anand manages IRRI projects in South Asia.



Mr. Malik, a farmer from Puri District, credits the timely application of fertilizers with the excellent growth of his rice crops (Photo: CSISA).

IPM
(No, it's not integrated pesticide management)

by Buyung **Hadi**

The evidence is mounting. If you drive through rural Southeast Asia between nine and eleven o'clock in the morning and roll your window down, you are likely to smell something synthetic in the air. Out in the fields, rice farmers are spraying insecticides.

Most Asian countries are importing an ever-increasing amount of pesticides. Food and Agriculture Organization of the United Nations data showed that Indonesia, Vietnam, Thailand, and India at least tripled their pesticide import values between 2000 and 2010. Many of these pesticides are used for rice production. The frequency of insecticide application in Java in Indonesia is among the highest in Southeast Asia.

Pesticide treadmill

For Asian farmers, insect pest outbreaks are characterized by uncertainty and surprise. Climate change aggravates the intensity of these uncertain events.

Southeast Asia is experiencing increasing occurrence of strong storms. In the wake of the storms, portions of rice fields are destroyed and sometimes replanted. A repeated cycle of replanting creates a large patchwork of asynchronous rice plots that provide a continuous resource for pest population buildup and lead to outbreaks. In the face of this challenge, many smallholder farmers choose prophylactic application of insecticide as a way to prevent loss.

The cheap, often subsidized price of insecticides encourages this behavior. Insecticide overuse accelerates the development of resistant pest populations, which, ironically, necessitates an ever-increasing amount of insecticide to be applied in the fields. Some call this the "pesticide treadmill" and it is a costly treadmill to be on, both financially and in terms of human and environmental health. A series of ill-health syndromes associated with pesticide exposure, including severe eye irritation and respiratory health problems, have been documented among Asian rice farmers. When the health problem costs are factored in, the prophylactic use of insecticide yields very little or even no profit for farmers.

Natural pest regulation

How did we reach this situation in which an unsustainable practice of overusing a single pest management option becomes the norm? Furthermore, this situation flies in the face of decades of promoting integrated pest management (IPM), a concept that emphasizes the integration of various pest management options, including host-plant resistance and biological control as well as chemical pesticides, across rural Asia. Indeed, some cynics point out that IPM really should stand for integrated pesticide management to reflect the current reality.

The conundrum is especially baffling since integrating various pest management options has been shown to work in the Asian rice context. Take the story of conservation biological control, for example. As one travels across rural China or Indonesia, the custom of planting rice bunds with various economic crops is quickly apparent. Sesame is commonly seen on the rice bunds of Zhejiang Province in China while various beans are planted by the rice fields of Yogyakarta in Indonesia. This practice may have started as a

IPM in action: Planting flowering plants around rice fields have been shown to conserve natural enemies and improve natural pest regulation so that insecticide use can be limited to occasions in which they are absolutely necessary (Photo by Sylvia Villareal, IRRI).

poor household strategy to squeeze the utility of idle land for subsistence food production.

Interestingly, increasing habitat diversity around rice fields by planting different vegetation on the bunds has been shown to also conserve the natural enemies of rice pests. Rice pests are constantly hunted by various other insects and spiders. Mirid bugs, for example, prey on pest species while tiny Trichogrammatid wasps parasitize pest eggs across Asian rice fields.

Rice pests are the major protein sources for most of these natural enemies, yet they also need plant-derived sugar and micronutrient to complete their dietary needs. Research conducted at the International Rice Research Institute (IRRI) and elsewhere in Asia showed that natural enemies lived longer and consumed more pests in the presence of bund vegetation that provides them with food and shelter. Consequently, the pest populations in fields with diverse bund vegetation are relatively lower and more stable than in fields with clean bunds.

When farmers experimented with the technique, the natural pest regulation in their fields was clear enough that they decided to reduce pesticide application *without being prompted to do so*. This shows that conserving natural enemies does improve natural pest control to the point that pesticide use can be limited to situations for which the pesticide is really necessary.

Sustaining IPM

So, if integrating pest management options actually works in the field, why don't we see this practiced more often? Perhaps the problem lies in the amount of investment involved in researching and promoting options other than pesticide. Indeed, among all of the major options for pest management (e.g., host-plant resistance, conservation and augmentative biological control, as well as pesticide), pesticide commands the largest industrial value.

The Asia-Pacific chemical pesticide market was estimated at USD 15.4 billion for 2017. Compare this with the biological control (biopesticide) market in the same region that was estimated at USD 1.26 billion for 2016. Most of the investment to introduce resistance genes into elite rice varieties comes from public funding and is nowhere near the numbers for biopesticide, let alone chemical pesticides.

It is often assumed that the key to a more sustainable practice in pest management is more information: if only farmers are equipped to make informed decisions, they will. This assumption fuels efforts such as the farmer field school and entertainment education campaign.

This might have worked if the playing field were level: that is, if all pest management options had equal amounts of research and promotion behind them. In reality, even as farmers are steeped in IPM information, sometimes the only real option that seems available is pesticide as the other options are either absent in the market or drowned by the din of strong promotion backed by large industries.

Thus, even as we continue to promote farmer education on IPM principles and knowledge, it is important to start paying attention to the amount of investment sustaining other pest management options.

Public funds will need to strategically flow into the inclusion and promotion of resistance genes in elite varieties. Market mechanisms should be used to prop up other options such as conservation and augmentative biological control. This will include policy work across the region to allow for registration, trade, and quality control of biopesticides.

SRP and IPM

It is interesting to note that, in some countries, it is possible to register older pesticides with known health risks while no legal procedure is available for the registration of commercial biological control. Another avenue worth pursuing is to create incentives for farmers to exhaust other nonchemical options such as the deployment of resistant varieties and usage of biocontrol options before pulling the trigger on chemical pesticides.

This is exactly the gist of pest management standards under the Standard Rice Platform (SRP). Level the field and farmer education will work better. Perhaps then we will see rice IPM in practice, and I'm *not* talking integrated pesticide management. ■

Dr. Hadi is an entomologist at IRRI.

Farmers in Southeast Asia are experiencing increasing occurrence pest outbreaks and choose the prophylactic application of insecticide as a way to prevent loss. (Photo by Chris Quintana, IRRI)

A cleaner strategy for sustainable Pakistani basmati rice

Most Pakistani farmers are not capable of making decisions on pest management and pesticide application and they often apply pesticides even when there is no real need or they use the wrong chemicals with the wrong doses, methods, and times.[1] Consequently, this led to greater problems and crop losses as the indiscriminate use of pesticide decimated beneficial organisms and created pest resistance. Additionally, shipments of basmati rice have been rejected by importing countries in Europe because of higher pesticide-residue levels.

Because high-pesticide residues and low grain quality have been major reasons basmati rice lots are rejected, IRRI and Rice Partners Limited (RPL), an international rice milling company headquartered in Islamabad, have developed a rice crop check system used as a benchmark for both farmers and quality control officers to follow. The system was introduced to alleviate these problems by providing farmers with information on economic injury levels and withholding period after spraying, and recommendations on harvesting and drying.

Using these quality standards for the paddy, RPL has established the purchase standards for basmati rice. If a contract grower does not meet these standards, the crop is rejected and will then have to be sold on the local market at a reduced price.

"Those who follow the guidelines and sell their crop to RPL receive a 10% premium above local market value," said RPL CEO Ali Tariq.

RPL is on track to have more than 1,000 contract farmers and sell 20,000 tons of brown basmati rice in Europe via Mars' Uncle Ben's® products by 2017. After that, the goal is to reach out to an additional 15,000 basmati growers in Pakistan.

Mars Food Incorporated is also partnering with IRRI, among others, to implement sustainable rice cultivation with basmati rice farmers using SRP. Currently, Mars, Inc. is helping almost 2,000 farmers in India and Pakistan learn new crop management practices that improve water use, reduce and safely manage the use of fertilizers and pesticides, and improve the health of farm workers. The American global manufacturer of confectionery and other food products is committed to sourcing 100% of its rice from SRP farmers by 2020.

See *From crop production to market: Improving the livelihood of Pakistan's basmati rice farmers* on pages 14-16 of *Rice Today*, November 2016.

[1] Parveen S & Nakagoshi N. (2001). An Analysis of Pesticide Use for Rice Pest Management in Bangladesh. J Int Dev Coop. 8(1)

Collecting data about the potential of AWD technology mitigating GHG emission in the Philippines. (Photo by Isagani Serrano, IRRI)

A Filipino farmer using an AWD pipe in his rice field. AWD enables farmers to save on irrigation water by up to 30% and reduces methane emissions by 30–70% without yield loss. (Photo by Isagani Serrano, IRRI)

Climate change action plans for rice farming:

FROM CONCEPTS TO IMPLEMENTATION

by Bernadette **Joven**

Rice-growing countries in Asia are moving toward the development and implementation of concrete mitigation programs to reduce the environmental footprint of the rice sector.

Despite a few setbacks, global climate agreements continue to tread on a positive path with more nations signifying official support for the Paris Agreement. However, although many countries are moving toward the implementation of concrete mitigation programs, there is a clear underrepresentation of the agricultural sector, especially in the rice-growing countries of Asia.

One possible mechanism to reach scale in implementing mitigation technologies is through Nationally Appropriate Mitigation Actions (NAMAs), one of the agreed outcomes from the Bali Action Plan concluded at the Conference of the Parties 18 in Doha, Qatar, in 2012.

NAMAs refer to any initiatives by developing countries, through government agencies such as agriculturee ministries, to reduce greenhouse gas (GHG) emissions. These can be policies directed at transformational change within an economic sector, or actions across sectors for a broader national focus, according to the United Nations Framework Convention on Climate Change. NAMAs are supported and enabled by technology, financing, and capacity-building aimed at reducing emissions relative to projected emissions in 2020 without these policies.

Funding for NAMAs could come from different sources, ranging from national budgets to bilateral donors or international funding agencies. This funding mechanism has been discussed at various climate change conferences since 2007, but the number of NAMA projects lags behind expectations. This led to the formation of new funding agencies such as the Climate and Clean Air Coalition (CCAC) and the NAMA Facility that support the design and implementation of eligible projects. The NAMA Facility conducts open competitive calls to identify the most ambitious, feasible, and transformational proposals for funding.

The Need for a Rice NAMA

Globally, agriculture contributes 10–12% of GHG emissions. But, emissions levels are higher in most Southeast Asian countries because of due to rice production. Although climate change affects impacts rice production, conversely, rice production could play a role in curtailing global warming; hence, the significance of NAMAs for rice production.

The the International Rice Research Institute (IRRI) is currently developing a NAMA prototype for Thailand's rice sector with the Thai Rice Department, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the Sustainable Rice Platform (SRP), and other public- and private-sector partners. This consortium was selected by the NAMA Facility for developing a full proposal for the funding of athe Detailed Preparation Phase (DPP).

Within the DPP, IRRI's tasks comprise of assessing GHG emission savings under different mitigation scenarios and technical backstopping on the implementation of alternate wetting-and-drying (AWD) technology in combination with laser land leveling and other crop management options.

"The Thai Rice NAMA concept was received favorably," said Dr. Reiner Wassmann, IRRI's climate change coordinator. "It focuses on applying AWD and the SRP standard and was suggested to consider the more technical options of crop management as a means to maximize the mitigation effect. We have teamed up with our colleagues from the Postharvest and Mechanization Unit to ensure technical expertise on laser leveling, straw management, fertilizer spreading, etc."

Other mitigation initiatives

The IRRI project on *Mitigation Options to Reduce Methane Emissions in Paddy Rice* provides technical support and guidance to policymakers in Vietnam and Bangladesh for implementing GHG mitigation technologies. Funded by the CCAC with the support from the CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS), this project aims to provide the foundation for future NAMA or NAMA-like projects for the rice sector.

"The CCAC Paddy Rice project focuses on the outscaling of

AWD technology in Vietnam and Bangladesh through support from national plans with geo-spatial information," explained Ole Sander, climate change scientist at IRRI.

AWD technology, which was developed by IRRI and its partners, addresses the twin problems of adaptation and mitigation through efficient water management. It enables farmers to save on irrigation water by up to 30% and reduces methane emissions by 30–70% without yield loss. This water-saving approach was also incorporated in the SRP standard that was designed to ensure the sustainability of rice production systems.

Recognizing the well-established benefits of using AWD, two consortia in Vietnam and Bangladesh and their respective agriculture ministries developed a work plan with IRRI for scaling out AWD in rice.

"Our national partners in both countries are strongly engaged in developing region-specific strategies for scaling out mitigation options in rice production," said Dr. Sander. "Collaboratively, we are developing solutions for specific local problems and bottlenecks."

Bangladesh has set a goal to scale out the use of AWD in 20% of all its rice cultivation.

In Vietnam, AWD is considered one of the key GHG emission mitigation technologies; thus, the aim for widespread adoption on up to 0.5 million hectares of rice paddy by 2030 is supported by the country's National Development Council implementation plan.

To facilitate information sharing, IRRI set up an online knowledge hub, where information on an array of mitigation technologies and practices can be accessed.

Moving forward

IRRI intends to establish a "Rice NAMA Clearing House" in its Vietnam office. To this end, IRRI organized an initial Stakeholder Workshop on climate change policies in Hanoi in June 2017 to discuss the Rice NAMA plans in Vietnam.

"The Clearing House will serve as a one-stop information platform for technical advice and collaborative engagement as we steer forward NAMA-related programs and projects in Asia," said Dr. Sander.

To train a cadre of experts on climate change mitigation, IRRI will offer training on various GHG mitigation technologies and practices in rice production in Asia. The training will feature various mitigation technologies and practices in Asia and GHG calculation tools. This would be vital for rice-growing countries in formulating and implementing their rice NAMAs. ■

Ms. Joven is a senior communication specialist at IRRI.

AWD is a water-saving approach incorporated in the SRP designed to ensure the sustainability of rice production systems. (Photo by Isagani Serrano, IRRI)

Women farmers' empowerment is a key ingredient for social sustainability

by Ranjitha **Puskur**

The Sustainable Rice Platform (SRP) adopted a triple bottom line (TBL) approach to assess the sustainability of rice agrifood systems. The TBL approach emphasizes the need not only to maximize profits (economic sustainability) through enterprises but also to better people's lives (social sustainability) and help the planet (environmental sustainability).

The social bottom line measures the long-term sustainability of human capital and, hence, the ability of enterprises to thrive. The license to operate enterprises depends greatly on their social sustainability efforts and impacts. A lack of social development, including poverty and inequality, can hamper business operations and growth. At the same time, actions to achieve social sustainability may unlock new markets, help retain and attract business partners, or inspire innovation for new product or service lines.

People first

Social development puts "people first" in development processes. Poverty is more than low incomes and is multi-dimensional. It is also about vulnerability, powerlessness, exclusion, and unaccountable institutions. This means that enterprises engaged in rice agrifood systems understand and respond to the needs of local communities, tailored to local contexts, and promote social inclusion, cohesion, and accountability. Although it is difficult to measure social bottom line because most benefits are intangible and nonquantifiable, it is nevertheless very important.

Social sustainability occurs when the formal and informal processes, systems, structures, and relationships actively support the capacity of current and future generations to create healthy and livable communities that are equitable, diverse, connected, and democratic, and provide good quality of life.

It is about identifying and managing business impacts—positive and negative—on people. Defining and measuring social indicators and tracking changes are important for the SRP to understand the impacts of rice value chains on the equity and well-being of vulnerable and marginalized population groups dependent on rice agrifood systems and inform the design of strategies or actions that would mitigate the negative impacts and amplify the positive impacts.

Women in rice

Women's empowerment has been chosen as one of the key dimensions in assessing social sustainability in the SRP because women play a critical role in rice production and other parts of agrifood systems.

Studies show that, on average, women contribute 43% of the labor in rice production in Asia. The increasing outmigration of men and youth from rural areas in search of employment and income-generating opportunities leaves rice farming and management in the hands of women. But, evidence shows that rural women face significant constraints in access to productive assets/resources (land, water, machinery, and tools) and services (extension, market information, credit). Women are underrepresented in decision-making roles. They receive unequal pay for equal work. Additionally, women-owned enterprises are economically disadvantaged and lack equal opportunity to compete for business opportunities.

In situations in which women are directly involved in rice production, women's empowerment (e.g., increasing women's access to knowledge) is expected to lead to higher productivity and profitability. Evidence also proves that empowering women and girls helps expand economic growth, promote social development, and establish more stable and just societies. Women's economic empowerment benefits both women and children, and leads to improved maternal health and improved family and community health and well-being.

Women in control

The United Nations Sustainable Development Goals underscore women's empowerment as an important development objective, in and of itself, and highlight the relevance of gender equality to addressing a wide range of global challenges.

The following dimensions have been chosen to develop key indicators for women's empowerment in the SRP:

- Women's control over household agricultural production and marketing decisions
- Women's control over use of household income
- Women's decision-making control over use of her time and labor
- Women's access to and control of productive resources and markets
- Women's mobility, social capital, leadership, and domestic violence
- Women's wage gap

These indicators have to be interpreted in context as socio-cultural situations, and norms have a significant influence on these dimensions. Women are also not a homogeneous group even within a given country or community. Intersectionalities beyond gender, such as age, class, ethnicity, religion, and location, come into play in determining the opportunities and challenges they face in accessing resources and services and benefiting from their use. Hence, it is difficult to determine standards and thresholds that would be universally applicable. ■

Dr. Puskur leads the Gender Research Program at the International Rice Research Institute.

FROM DUST BOWL TO RICE BOWL

by Savitri **Mohapatra**

Conservation agriculture has a vital role to play in sub-Saharan Africa's food security for a population projected to rise to 2 billion by 2050.

It is the harmattan season when dry, dust-laden winds from the Sahara Desert sweep across West Africa. "As you can see, we had almost no rainfall here," said Kouakou Ali, a technical assistant at the Africa Rice Center (AfricaRice), pointing to a landscape of devastation caused by bush fires, near the rice fields in M'bé in Côte d'Ivoire. In 2016, Côte d'Ivoire experienced the worst harmattan in three decades.

Farmers in rainfed drought-prone areas are increasingly vulnerable to agricultural risks from a changing climate. According to environmental experts, climate change threatens to turn vast areas of productive land in Africa into dust bowls, leading to widespread hunger and migration of rural populations on a much bigger scale than the Dust Bowl that devastated North America in the 1930s.

Lessons from the Dust Bowl

Caused by severe drought and unsustainable dryland farming practices, the Dust Bowl taught hard lessons that motivated a fundamental change in mindset of some agricultural experts to move away from intensive tillage-based agriculture, which was found to accelerate soil erosion in dryland systems, to an approach called "conservation agriculture."

Conservation agriculture is a set of soil management practices that are based on three principles: (1) maintaining organic matter cover over the soil throughout the year using cover crops and intercrops and/or mulch provided by crop residues, (2) minimizing soil disturbance by tillage and seeding directly into untilled soil, and (3) diversifying crop rotations and associations, including nitrogen-fixing legumes.

A promise for Africa

Some of the principles of conservation agriculture are not new to Africa. Smallholder farmers traditionally grew cowpea or groundnut, in rotation with cereals or as intercrops, and then left their land fallow for several years to restore soil fertility. But, with high population pressure, the fallow periods have become shorter and the cropping periods longer.

As a result, soil fertility and crop yields have declined drastically. In some areas, the soil has become so dry and hard that even the rains bring little relief for farmers as the water runs off, taking the precious topsoil with it. It is reported that about 65% of the arable land in Africa is already degraded and several countries are facing critical food shortages.

Sustainable farming practices such as conservation agriculture have a vital role to play in sub-Saharan Africa, where the population is projected to rise to 2 billion by 2050. With increasingly scarce resources, it is critical for the region to abandon farming practices that mine the soil and adopt those based on resource-use efficiency and conservation of natural resources.

Keeping this in mind, the Food and Agriculture Organization of the United Nations, the New Partnership for Africa's Development, the Alliance for a Green Revolution in Africa, the African Conservation Tillage Network, French Agricultural Research for Development (CIRAD), and CGIAR Research Centers and Programs, among others, are investigating the potential of conservation agriculture approach in Africa.

Advantages for upland rice

CIRAD has developed several cropping systems for uplands, based on conservation agriculture, such as improved fallow systems using *Stylosanthes guianensis*, a forage legume, as a cover crop. The legume

helps restore soil fertility through high biomass production and nitrogen fixation.

These systems could be sustainable and profitable in places where soils are vulnerable. The improved fallow systems could also be attractive to upland farmers in Madagascar, particularly when they have cattle to feed.

Research by AfricaRice, CIRAD, and the Centre National de la Recherche Appliquée au Développement Rural (FOFIFA), the national research institute of Madagascar, has confirmed that growing a legume cover crop following a zero-tillage approach is an efficient strategy to control the destructive parasitic weed *Striga asiatica* in upland rice. This strategy is being widely promoted through a farmer-learning video, available in local languages.

Healthy soil, healthy rice

AfricaRice and CIRAD are developing cropping systems based on conservation agriculture principles for the agronomic management of biotic stresses in rice such as pest, diseases, and weeds. "Our aim is to co-design with local farmers cropping systems that can provide plant protection with minimum inputs," said Olivier Husson, CIRAD/AfricaRice systems agronomist.

As part of this research, Dr. Husson and his team are developing standardized methods for measuring three parameters, which can be used to efficiently characterize soil/plant conditions and indicate the robustness of cropping systems against biotic stresses.

"In this research, we are testing a new concept for managing pests and diseases," observed Dr. Husson. "Instead of trying to control these stresses through adjustment of farming practices, we aim at increasing biodiversity through cropping systems to alter the environment and make it unfavorable for the biotic stresses."

If this succeeds, it will open a new approach for integrated pest management.

Experiments on conservation agriculture for rice-based cropping systems have been set up at the AfricaRice research station in M'bé. Different crop/cover crop associations and rotations and soil management practices are being tested so that

In West Africa, many farmers lose their crops every year to bushfires that occur in the dry season. (Photo by R.Raman, AfricaRice)

Dr. Husson tests different crop cover crop associations and rotations based on conservation agriculture in M'bé. (Photo by R. Raman, AfricaRice)

farmers can pick what fits them best or could be adapted to meet their constraints and means.

The impact of these systems on pest development will be studied improve their performances.

Building the capacity of national agricultural research and extension systems in Africa on conservation agriculture in integrated rice-based systems is a major component of this collaborative work. The experiments at M'bé serve as a training and demonstration platform site where researchers and farmers can interact and learn from each other.

Climate-smart approach

"M'bé is an ideal place to work because of its harsh climatic conditions for upland rice," said Dr. Husson. "We are trying to develop rice-based production systems that are ready for the future, so that they can respond better to the challenge of climate change and increasing water scarcity."

According to the CGIAR Research Program on Climate Change, Agriculture and Food Security, conservation agriculture can increase resilience to climate change and has the potential to contribute to climate change mitigation by building the soil's capacity to store carbon dioxide.

Challenges and opportunities

As conservation agriculture is knowledge-intensive, it requires a deeper understanding of ecological processes. It also calls for new skills and a change in mindset. For smallholders, this is a big challenge as any change in their farming practices implies risks.

The lack of a simple recipe for restoring soil health everywhere is another challenge for its large-scale adoption. However, it offers great opportunities for researchers to work with farmers to diagnose local soil and climatic conditions and redesign appropriate cropping practices.

"Despite very unreliable rainfall in the past three years in M'bé, we could produce a minimum of 800 to 1.2 tons per hectare every year without mineral fertilization application and tillage and with very limited weeding," said Dr. Husson. "We are minimizing the risk taken by farmers and providing a benefit every year and achieved yields of up to 4 tons per hectare with fertilization. This shows that, if we learn to use the strength of nature, instead of fighting it, we can restore soil fertility rather quickly." ■

Ms. Mohapatra is the head of Marketing and Communications at AfricaRice.

Productivity growth is important for sustainable rice production

by Achim **Dobermann**

Definitions of "sustainable" that can be found in dictionaries include "able to be maintained at a certain rate or level," "conserving an ecological balance by avoiding depletion of natural resources," or "causing little or no damage to the environment and therefore able to continue for a long time." There is nothing wrong with that, except that we are missing a trick: being sustainable by just preserving the status quo in productivity or the environment will not be good enough for the transformative changes we need to make in the world's agrifood systems.

When I first joined the International Rice Research Institute (IRRI) as a young scientist in 1992, "sustainable" was not yet a widely used term. Instead, in those days, we were hugely concerned about yield potential, stagnating or declining yields, and low nitrogen-use efficiency in the world's most intensively managed rice baskets of Asia. It was thought that something might not be quite right with these systems, something might indeed not be "sustainable." Hence, a strategic, interdisciplinary project on sustaining soil quality in intensive rice systems was launched to look into the potential causes of stagnating yields.

Luckily, it turned out that there was nothing inherently wrong with doing intensive rice monoculture and that this was, in fact, a very sustainable system—if managed well. That was a key lesson I personally learned from this early research: if we want to have highly productive, efficient, and sustainable agricultural systems, we must manage them precisely with a lot of knowledge embedded in every decision to make along each growth cycle. An important personal consequence of this work was that I shifted my attention to finding new solutions for the site-specific management of nutrients, which one can view as a common currency for achieving high productivity as well as environmental goals.

I left IRRI in early 2000 and re-joined seven years later. In the meantime, to my surprise, there had been less emphasis on investment in research on yield potential, closing yield gaps, or productivity enhancement in intensive rice systems, even though those supply three-quarters of the world's rice. Priorities in public sector research had shifted more toward less favorable rice environments, although it was felt that for intensive rice systems one needed to mainly sustain their productivity levels while improving a wider range of ecosystem services. Moreover, in the late 1990s, two new terms were coined by scientists to describe future paradigms for achieving food and nutrition security while also protecting the environment.

"Ecological intensification"(EI) of agriculture was described as a process of improving both yields and environmental performance of crop production on existing land, with a focus on precise management of all production factors and maintenance or improvement of soil quality. "Sustainable intensification" (SI) of agriculture was originally associated more with low-input agricultural options to reduce negative impacts on the environment and improve broader ecosystem services. Nowadays, the term SI is widely used by the scientific community—primarily in the West—to describe a much broader transformation of agrifood systems. A consensus has emerged that such a sustainable intensification must happen on small and large farms throughout the world, although opinions differ on how this can be achieved.

I think the rice crisis that hit the world in 2008 was a wake-up call, reminding everyone that investment in productivity-enhancing R&D must continue because, otherwise, it is impossible to achieve food security and SI in a world with a growing population and harsher climate. One positive outcome of the crisis was an increased interest in the private sector in rice, and the realization that addressing complex challenges such as sustainable intensification requires working in partnership, including public-private platforms that bring together many stakeholders along the value chain.

Establishing the Sustainable Rice Platform (SRP) in 2011 was, therefore, a logical consequence of the changing times. I was extremely pleased when the first version of the SRP Standard on Sustainable Rice Cultivation and its 12 performance indicators was published in 2015 by a coalition of the 28 SRP members at the time, bringing together a tremendous amount of science, knowledge, and practical experiences. Hence, it is my sincere hope that things can be kept simple and actionable and that governments, public funders, and private companies will invest much more in bringing these good management practices to millions of rice farmers. This will make a huge difference. ■

Dr. Dobermann is the director and chief executive at Rothamsted Research.

Gelia T. Castillo (1928-2017): Helping science to serve a human purpose

by Gene **Hettel**

Dr. Gelia T. Castillo, 89, a Philippine National Scientist and long-time consultant at the International Rice Research Institute (IRRI), passed away on 5 August 2017. Born on 3 March 1928 in Pagsanjan, Laguna, Philippines, she is recognized internationally as a respected and outstanding Filipino rural sociologist. Her publications are major and definitive works on Philippine agricultural and rural development. These include *All in a Grain of Rice*, known to be the first book written by a Filipino about the Filipino farmer's response to new technology, and *Beyond Manila*, cited as an in-depth and analytical study of the actual problems and needs of rural areas in relation to countryside development.

These works gave Filipinos insight into their own rural development efforts and their attempt to reach farmers and the rural poor. All her professional life, she was guided by the precept that "science must serve a human purpose."

"Over recent years, Gelia continued to regularly attend events at IRRI and, despite her declining health, provided us with such a vibrant example of intellectual vitality, lifelong curiosity, and passion for knowledge," noted IRRI Director General Matthew Morell. "She was a truly remarkable person."

Dr. Castillo received her AB (psychology), MS (rural sociology), and PhD (rural sociology) degrees, respectively, from the University of the Philippines (1948), Pennsylvania State University (1958), and Cornell University (1960).

She began her professional career as an instructor in psychology and sociology in the Department of Agricultural Education, College of Agriculture, University of the Philippines (UP, 1953-57). She went on to become an assistant professor, associate professor, and full professor of rural sociology at the UP College of Agriculture, respectively, 1960-66, 1966-72, and 1972-88. In 1988, she was appointed to the highest rank of university professor (one of the first six appointees to such a position at UP, which she held until her retirement in 1993). On 3 March 1993, she was appointed as professor emeritus.

In 1999, she was conferred the rank and title of National Scientist by the President of the Philippines. She also received the Distinguished Alumnus Award of the UP Alumni Association (1975), the Rizal Pro Patria Award (1976), and the Distinguished Alumnus Award of the UP College of Agriculture (1979).

Outside the Philippines, she was a teaching and research assistant and visiting professor in the Department of Rural Sociology, Cornell University, 1958-60 and 1966-67, respectively.

At IRRI, she served as a visiting scientist in the Social Sciences Division during the mid-1980s and was a consultant to the institute from 1994 to 2013. She was truly the *grande dame* of the IRRI community. She was contributing her social science expertise to the early efforts of the institute's fledgling Agricultural Economics Department as far back as the 1960s. More than half a century later, she was still asking piercing questions at Thursday Seminars and making pithy on-the-mark observations during IRRI's annual scientific reviews.

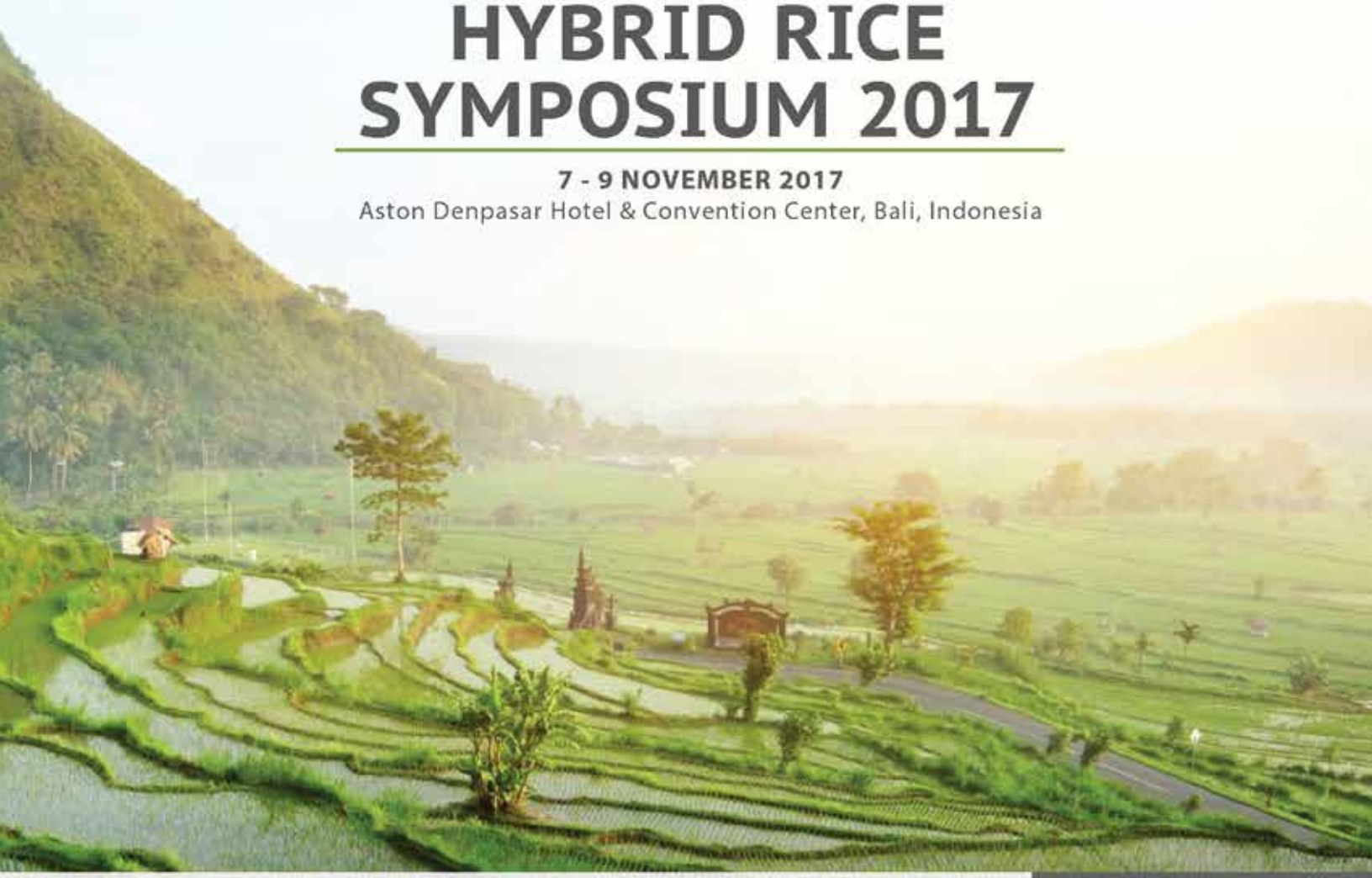
Her **2009 IRRI *Pioneer Interview*** *(https://goo.gl/uvzpas)* displayed her great enthusiasm, zest, and love for rice, rural sociology, and life itself.

"She was a tireless champion for our relations with the national agricultural research systems," stated IRRI Director General Emeritus Robert Zeigler, who worked closely with Dr. Castillo during her final years at IRRI. "She always reminded me of how important training was and is for IRRI to remain relevant." ■

INTERNATIONAL HYBRID RICE SYMPOSIUM 2017

7 - 9 NOVEMBER 2017

Aston Denpasar Hotel & Convention Center, Bali, Indonesia



CALL FOR PARTICIPANTS

We are pleased to announce that the International Rice Research Institute (IRRI) and the Directorate of Rice Research Institute are organizing the ***International Hybrid Rice Symposium***, to be held on 7-9 November 2017 in Bali, Indonesia.

The symposium will gather hybrid rice researchers and other experts and representatives from the public and private sectors and provide a platform for discussion among these stakeholders, specifically on issues related to hybrid rice. Covered topics will include hybrid rice development and seed production, applications of molecular technology, crop and resource management, and economics.

The 3-day program will feature keynote lectures, paper presentation sessions, workshops, a field visit, and a hybrid-rice technology exhibit.

By joining the symposium, participants will be enrich their knowledge on hybrid rice, keep abreast of recent developments in science and industry, learn about cutting-edge research, and meet and network with experts and various stakeholders of the rice industry.

To learn more about the symposium or register as participant, visit **www.hybrid-rice.org**

International Hybrid Rice Symposium 2017 Secretariat

c/o MCI Management
Malaysia Sdn Bhd (1015937-W)
Suite 12.9, Level 12, Wisma UOA II, 21
Jalan Pinang 50450 Kuala Lumpur
Tel: +603-2162 0566
Fax: +603-2161 6560
Email: hybrid-rice@mci-group.com
Website: www.hybrid-rice.org