Growing rice, cultivating partnerships:

40 years of Indonesia–IRRI collaboration

International Rice Research Institute (IRRI)

IRRI is the world's premier research organization dedicated to reducing poverty and hunger through rice science; improving the health and welfare of rice farmers and consumers; and protecting the rice-growing environment for future generations. Headquartered in the Philippines and with offices in 17 countries, IRRI is a global, independent, nonprofit research and training institute supported by public and private donors.

IRRI breeds and introduces advanced rice varieties that yield more grain and better withstand pests and disease as well as flooding, drought, and other harmful effects of climate change. The Institute develops new and improved methods and technologies that enable farmers to manage their farms profitably and sustainably. IRRI recommends rice varieties and agricultural practices suitable to particular farm conditions and consumer preferences. Finally, IRRI assists national agricultural research and extension systems (NARES) in formulating and implementing national rice sector strategies and programs.

IRRI is a member of the CGIAR consotium and, among global partners, leads Global Rice Science Partnership (GRiSP) that provides a single strategic plan and unique new partnership platform for impact-oriented rice research for development.

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Introduction

In the past 40 years, Indonesia's efforts to produce enough rice for its people have been inextricably interwoven with its partnership with the International Rice Research Institute (IRRI). This partnership has increased Indonesia's ability to both feed its population and improve the incomes and, consequently, the living conditions of its millions of farmers and rural folk. It has also created and nurtured a pool of Indonesian scientists and researchers vital to the country's performance in rice production and processing.

Greater expectations and hopes are now pinned on the Indonesia-IRRI partnership. A resurgent Indonesian economy, coupled with a fast-growing population, is expected to boost demand for rice. Meanwhile, unceasing and increasing competition for land and water from other uses, the projected thinning of the world rice market, as well as the worsening impact of climate change, have placed tremendous pressure on the Indonesian rice industry to achieve higher performance in making rice available, at affordable prices, to everyone.

Rice in the Indonesian economy

Rice is the most important agricultural commodity in Indonesia. It is the staple of Indonesians who each consume an average of 135 kg of rice every year, or a total of around 38.4 million tons in 2012. An Indonesian, on average, spends 60% of his income on food, and of this expenditure, 25% is spent on rice. Meanwhile, some 20.5% of the country's 39.7 million hectares (ha) land area are under paddy cultivation. It is estimated that 14.2 million Indonesian farming households directly derive livelihood from rice.

Throughout its history, Indonesia struggled to produce enough rice for its people. Its population from 2003 to 2012 increased at an average rate of 1.5% a year, from 217.9 million to 248.8 million, the fourth largest in the world. In the meantime, paddy production increased at an average rate of 3.2% a year, from 52.1 million tons to 69 million tons. Despite the rice production growth rate outstripping that of population, this growth rate had not been enough. As a result, Indonesia imported an average of 0.8 million tons of paddy a year, during this period, with peaks in the years 2007, 2011, and 2012 when it brought in 1.4 million tons, 2.8 million tons, and 1.8 million tons, respectively (Table 1 and Figure 1). These imports cost the country an average of US$438.85 million a year.

Table 1. Indonesia rice imports and exports, 2003-12.

Year	Imports (ton)	Exports (ton)
2003	1,429	-
2004	237	-
2005	189,616	42,286
2006	438,108	959
2007	1,406,847	1.613
2008	289,689	589
2009	250,473	2.455
2010	687,581	345
2011	2,750,476	377
2012	1,810,372	897
Average	782,483	5,718

Source: CBS, 2013.

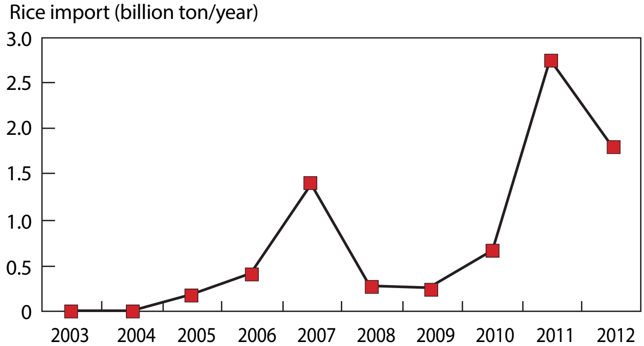


Figure 1. Rice imports in Indonesia, 2003-12.

Indonesia's efforts toward achieving food security over the last quarter of the century, have continued mostly on increasing productivity rather than about area expansion. Because of persistent land conversion of an estimated 100,000 ha a year, the country's annual rate of rice area expansion has declined, from 2% in 1960-98 to less than 0.1% in 1999-2010 (Table 2 and Figure 2). If the country is to keep pace with the demand for the commodity, it has to increasingly rely on increases in yield.

Table 2. Rice harvested area, productivity, and production, Indonesia, 1999-2012.

Year	Harvested area (ha)	Productivity (t/ha)	Production (t)
1999	11,963,204	4.252	50,866,387
2000	11,793,475	4.401	51,898,852
2001	11,499,997	4.388	50,460,782
2002	11,521,166	4.469	51,489,694
2003	11,488,034	4.538	52,137,604
2004	11,922,974	4.536	54,088,468
2005	11,839,060	4.574	54,151,097
2006	11,786,430	4.620	54,454,937
2007	12,147,637	4.705	57,157,435
2008	12,327,425	4.894	60,325,925
2009	12,883,576	4.999	64,398,890
2010	13,253,450	5.015	66,469,394
2011	13,203.643	4.980	65,756,904
2012	13,445,524	5.136	69,056,126

Source: CBS, 2013.

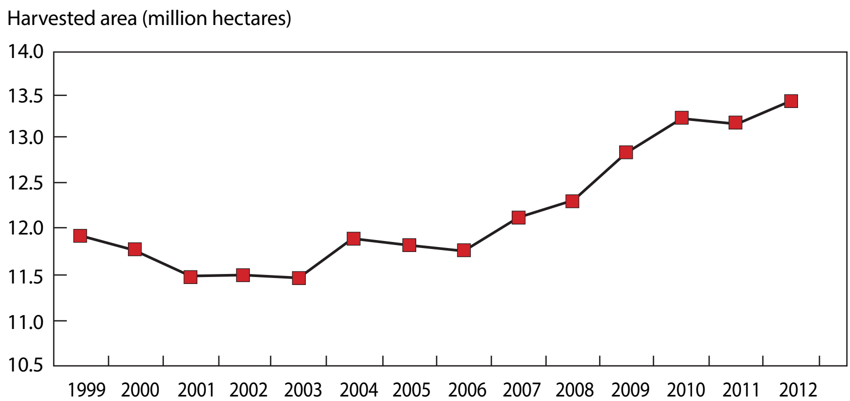


Figure 2. Area harvested of paddy in Indonesia, 1999-2012.

Indonesia–IRRI collaboration: The past 40 years

The partnership between IRRI and Indonesia throughout the past 40 years has been marked by each partner drawing on and nurturing the other's strengths, while constantly revising the nature and directions of their collaboration to ensure that the partnership remains relevant. This partnership has resulted in Indonesia producing rice for hundreds of thousands more Indonesians a year, giving millions of Indonesian farmers the opportunity to increase earnings from higher yields and reduced losses, and nurturing a cadre of Indonesian scientists who are well-taught and well-trained in the science of rice production and processing, and on whose shoulders rest the future of the rice self-sufficiency efforts of Indonesia.

The IRRI office in Indonesia is located at the compound of the Indonesian Agency for Agricultural Research and Development in Bogor.

IRRI, for its part, has been able to draw from the knowledge of Indonesian scientists and researchers. Through this partnership, IRRI was able to test its breeding lines under Indonesian agroclimatic conditions, thus increasing its capacity to deliver rice production and processing technologies better adapted to local conditions. It is through this and other collaborations that IRRI has been able to pursue its mission of reducing poverty and hunger, improving the health of rice farmers and consumers, and ensuring the environmental sustainability of rice farming.

Collaboration between the government of Indonesia and IRRI formally began on 20 December 1972, when both agreed to forge the first of many memoranda of understanding (MOUs) for the improvement of rice research through Indonesia's National Rice Research Program. More specifically, the agreement sought to (1) develop a coordinated rice research program for the Ministry of Agriculture that will focus on rice production and related multiple cropping; (2) formulate a manpower development and training program aimed at meeting present and future needs for capable and qualified research and extension workers in Indonesia; and (3) establish regional rice research stations under the supervision of the national program, to decentralize rice research in Indonesia.

Six years later, another MOU was signed by the directors general of IRRI and the Indonesian Agency for Agricultural Research and Development (IAARD). This agreement prioritized genetic evaluation and utilization of rice, implementation of improved rice-based cropping systems, development and testing of machinery for small-scale farming, and formal academic training and specialized nondegree training of Indonesian scientists. At this early stage, support was received from various sources such as the Ford Foundation, the United States Agency for International Development, the Japan International Cooperation Agency, and the Government of the Netherlands.

Another MOU, signed on 30 August 1984, underlined the importance of genetic evaluation and utilization for different ecosystems, particularly uplands, high-elevation areas, tidal wetlands, and swampy areas. It also covered research collaboration in water management, sharing of genetic resources, scientist exchange, and co-publication of research results and other information materials.

In recognition of the Institute's role in helping Indonesia achieve rice self-sufficiency in the 1980s, President Suharto presented the *Bintang Jasa Utama*, the country's highest merit award, in 1989, to then IRRI Director General Klaus Lampe.

Six other MOUs, each in effect for a five-year period, followed. These agreements continued to give top priority to the evaluation and utilization of various rice genes for various ecosystems and the management of rice genetic resources, while also focusing on forecasting pest and disease epidemics, improving soil quality, and the generation and promotion of yield-increasing and loss-reducing technologies.

Result area 1: Development of modern varieties adapted to Indonesian conditions

The most visible and impactful result of this partnership are the modern varieties developed from shared genetic resources. Developed together with these varieties were the cultural management technologies that ensure optimal returns from their cultivation.

The varieties developed. Of the 194 varieties released in Indonesia from 1980 to 2009, 172 (88.7%) had progenies linked to varieties developed by IRRI. Of these IRRI-linked varieties, 19 (9.8%) were direct releases from IRRI while the majority (108 or 55.7%) had parents from IRRI, and the rest (45 or 23.2%) had ancestors from IRRI (Table 3).

Table 3. Number of varieties released in Indonesia by origin, 1980-2009.

Origin of variety	1980-89		1990-99		2000-09		Total 1980-2009	
	No.	%	No.	%	No.	%	No.	%
Varieties with IRRI links	63	90.0	34	82.9	75	90.4	172	88.7
• IRRI releases	17	24.3	2	4.8	0	0.0	19	9.8
• IRRI parent	34	48.6	25	61.0	49	59.1	108	55.7
• IRRI ancestor	12	17.1	7	17.1	26	31.3	45	23.2
Varieties with no IRRI links	9	10.0	7	17.1	8	9.6	22	11.3
Total 70	100.0	41	100.0	83	100.0	194	100.0	

Table 4. Number of rice varieties released in Indonesia by percentage contribution of IRRI to progeny, 2010-2012.

IRRI contribution	No.	Percentage share
100%	7	19.4
50%	8	22.2
25%	5	13.9
0%	16	44.4
Total	36	100.0

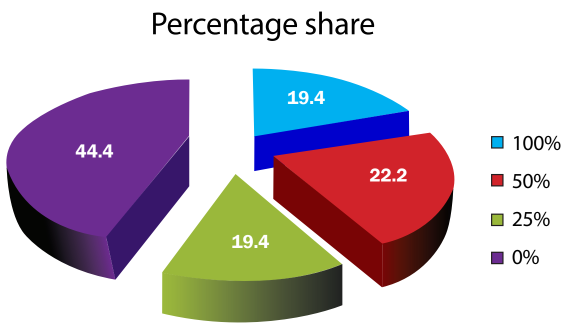


Figure 3. Share of released rice varieties by IRRI contribution to progeny, 2010-2012.

Moreover, of the 36 varieties released in 2010-12, the majority (20 or 55.6%) had links with IRRI varieties. Of these varieties, those on which IRRI has 50% contribution accounted for the largest proportion (22.2%) while those on which IRRI has 100% contribution accounted for 19.4%. Those on which IRRI has 25% contribution accounted for the rest (Table 4 and Figure 3). Annex 1 contains the list of these varieties.

The first of the IRRI breeds introduced into Indonesia came after a brown planthopper (BPH) infestation that broke out in the middle of the 1970s, and devastated the rice crop, which then consisted mainly of Pelita, a national rice variety. These IRRI breeds were IR26, IR30, and IR32, which were resistant to BPH biotype 1. IR36 was introduced in 1978 after the more virulent BPH biotype 2 attacked the rice crop. IR36 became the predominant variety planted in the country until the late 1980s. In 1986, IR64, a short-maturing variety with good eating quality and tolerant of BPH biotypes 1 and 2, was released and, in a very short time, became the predominant variety in major rice-producing regions in the country. This remained the case until recently when reports suggested that it has become susceptible to BPH and viral disease tungro. National variety Ciherang, which was developed from IRRI lines and released in 2000, is now the predominant variety in Indonesia.

More recently, IRRI and Indonesia's varietal improvement efforts have been focused on addressing the need for rice varieties better adapted to unfavorable rice environments made worse by stresses caused by climate change. These varieties include:

1. Flood-tolerant varieties. Flood-tolerant rice contains the submergence 1 gene (*SUB1*) that allows it to survive 10–14 days of complete submergence. In Indonesia, three flood-tolerant rice varieties have recently been developed with IRRI participation and then released by the national system:
   - Inpara 4, released in 2010, came from the Indian mega variety Swarna, is of medium maturity (135 days), and can tolerate up to 14 days of submergence. It is moderately resistant to BPH 3, and is resistant to BLB pathogen types IV and VIII;
   - Inpara 5, released in 2010, was developed from IR64. It is early maturing (115 days), and can tolerate up to 14 days of submergence; and
   - Inpari 30/Ciherang-sub1, released in 2012, is early maturing and can tolerate submergence of up to 14 days.
2. Salinity-tolerant varieties. Salinity-tolerant varieties grow well in salt-stressed lands such as (a) coastal areas that suffer from seawater intrusion; (b) inland areas where the underlying rock is rich in harmful salts; and (c) areas where excessive irrigation is used without proper drainage. Their yields are comparable to, and sometimes better than, those of salinity-intolerant varieties planted in normal soil. In 2011, elite salinity-tolerant lines were tested in the coastal area of Indramayu. Results of these tests were promising: Inpari 34 Salin Agritan and Inpari 35 Salin Agritan, both with IRRI progenies, had respective yield potentials of 8.1 tons/ha and 8.3 tons/ha, and average yields of 5.1 tons/ha and 5.3 tons/ha, while being tolerant of salinity during seedling stage at 12 decisiemens per meter (dS/m).

3. Upland varieties.Varieties suited for upland conditions must have cold tolerance, blast resistance, aluminum toxicity tolerance, and good grain quality, among other traits. These varieties will enable Indonesia to make full use of its upland ecosystem, which consists of 1.16 M ha currently under cultivation; 5 M ha of potential areas in Sumatra, Kalimantan, and Papua; and 2 M ha of potential area for intercropping with young forest and estate crops. Of the upland varieties now in use in Indonesia, Inpago 5, 6, and 7 are the products of Indonesia-IRRI collaboration (Table 5).

4. Golden Rice. Golden Rice was developed using genetic modification with genes from maize and a common soil microorganism that together produce beta carotene in the rice grain. Golden Rice is being tested in confined and multilocation field trials to ensure its adaptability to local conditions, that is, that its potential yield is not reduced substantially, and that it does not lose pest resistance and good grain qualities. The tests also ensure that, based on internationally-accepted standards, Golden Rice does not pose danger to human and animal health as well as to the environment. In Indonesia, these genes will be transferred into the IR64 and Ciherang varieties.

Table 5. Released new rice varieties well adapted to upland conditions in Indonesia, 2010-12.

Variety	Selection number	Origin	Year released
Inpago 4	TB490C-TB-1-2-1 Batutegi/ Cigeulis/Ciherang	TB490C-TB-1-2-1 Batutegi/ Cigeulis/Ciherang	2010
Inpago 5	B11338F-TB-26 TB177E-TB-28-D-3/ B10384E-MR-18-3//IR60080-23// TB/177E-TB-28-D-	B11338F-TB-26 TB177E-TB-28-D-3/B10384E-MR-18-3// IR60080-23//TB/177E-TB-28-D-	2010
Inpago 6	IR 30176-B-2-MR-1 IRAM2165/ NC1281	IR 30176-B-2-MR-1 IRAM2165/ NC1281	2010
Inpago 7	B12498E-MR-1 IR68886/PB68/ Slegreng///	B12498E-MR-1 IR68886/PB68/ Slegreng///	2011
Inpago 8	TB409B-TB-14-3 Cirata/TB177	TB409B-TB-14-3 Cirata/TB177	2011
Inpago 9	B12151D-MR-4 UPLRI/IRAT15	B12151D-MR-4 UPLRI/IRAT15	2012

5. Green Super Rice (GSR). GSR lines are being developed under the GSR for the Resources-Poor of Africa and Asia Project of IRRI with funding support from the Bill & Melinda Gates Foundation. GSR lines produce high and stable yields using low input, thus substantially reducing the production cost of farmers. GSR lines can also be custom-made to fit any target ecosystem. For example, GSR lines can grow rapidly to compete strongly with weeds. Because they establish themselves much faster than the weeds, herbicide—a luxury for poor farmers—becomes unnecessary. There are also drought-tolerant GSR lines with IR64 as the recurrent parent. For example, IR83142-B-19-B, a GSR line, performs better than Sahbhagi dhan under drought and zero-input conditions (no fertilizers and pesticides, and only one manual weeding). Moreover, 56 GSR lines with multiple resistance to rice blast, rice planthoppers, and gall midge have been distributed to the GSR trial countries for more thorough evaluation.

   Some 106 GSR lines are now ready for seed exchange and germplasm distribution through the International Network for the Genetic Evaluation of Rice. These "finished products" include GSR materials that are drought-tolerant and suitable for rainfed lowlands, and inbreds and hybrids with multiple disease and insect pest resistance. They also include drought-tolerant, salinity-tolerant, flood-tolerant, and high-yielding varieties suitable for irrigated conditions.

Dr. Jauhar Ali, IRRI plant breeder, works with Indonesian partners in testing and evaluating GSR lines.

Yield increases from modern varieties. The availability and adoption of these varieties had dramatically increased yields in Indonesia. In 1972, when the Indonesia-IRRI collaboration was first formally established, paddy yields in the country averaged 2.46 tons/ha. These grew by 2.7% per year to an average of 2.89 tons/ha 6 years later, when the second Indonesia-IRRI MOU was signed. By 1990, when the fourth MOU was signed, these averaged 4.30 tons/ha, 48.8% higher than 12 years before. These continued to grow at an average of 0.7% per year to reach 4.98 tons/ha in 2011, twice that of 40 years ago (Table 6 and Figure 4).

Table 6. Average paddy yields in Indonesia, various years at 6-year intervals, 1972-2008, and in 2012.

Year	Average yield (t/ha)	Annual growth rate
1972	2.46	-
1978	2.89	2.7
1984	3.91	5.9
1990	4.30	1.7
1996	4.42	-3.1
2002	4.40	-0.1
2008	4.89	0.8
2012	5.14	0.7

Source: IRRI World Rice Statistics, citing FAO data, http://ricestat.irri.org:8080/wrs2/entrypoint.htm.

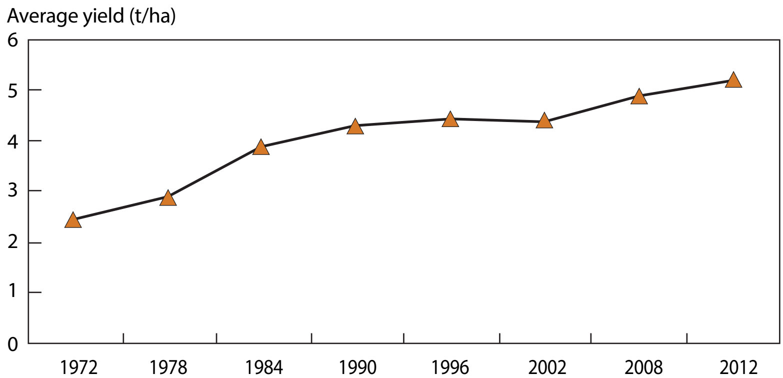


Figure 4. Average paddy yields in Indonesia, various years at 6-year intervals, 1972-2008, and in 2012.

Value of IRRI contribution to yield increases in Indonesia. Yield improvements from 1985 to 2009 had been valued at a total of $5.4 billion. The value of yield increments rose from $200 million to $400 million a year from 1989-2002. This pace of growth rose thereafter, reaching $1 billion in 2006, and $3 billion in 2008 due to historically high prices and markedly high yield increments. The value of yield improvements averaged $850 million annually during the entire period.

A large majority (73.8%) of these yield increments was attributed to IRRI, which contributed a total of $4 billion, or an average of $644 million/year (Figure 5). This contribution meant an average additional income for Indonesian farmers of $ 76/ha/year. It was most impressive over the last two years of the 24-year period, at $496/ha in 2008 and $344/ha in 2009.[1]

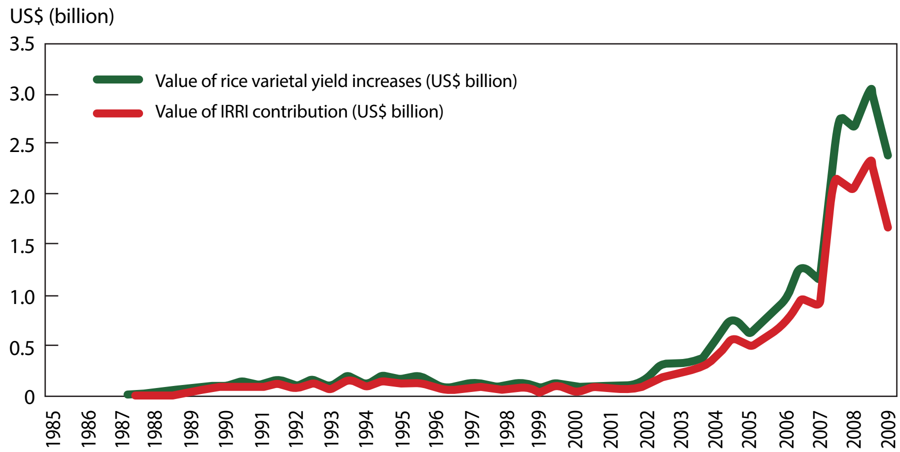


Figure 5. Total value of yield increments in Indonesia and IRRI contribution, 1985 to 2009.

Result area 2: Development of production and postharvest technologies

IRRI and its national partners also develop management practices and proccesing technologies for optimum performance of its modern varieties. Policy briefs to assist rice policy makers, formulators, and implementers in better ensuring informed programs are also developed. The Institute has shared these technologies as well with other rice producing countries, including Indonesia.

The most recent of these technologies are those developed under the Irrigated Rice Research Consortium (IRRC) whose creation IRRI initiated and supported.

[1]Brennan JP and Malabayabas A. 2011. International Rice Research Institute's contribution to rice varietal yield improvement in South-East Asia. ACIAR Impact Assessment Series Report No. 74. Australian Centre for International Agricultural Research: Canberra. 111 pp.

Established in 1997, IRRC serves as a platform for expediting partnerships between NARES and IRRI scientists. This Consortium aims to identify, develop, disseminate, and promote the adoption of natural resource management (NRM) technologies suitable for irrigated rice-based ecosystems in several Asian countries. Instead of a "top-down" research and dissemination approach, the institutional structure of IRRC was expressly developed to emphasize the importance of partnerships and to make sure that local NARES are involved in identifying technologies appropriate for further study and research. The ultimate goal is the adoption of these technologies in their respective countries. The technologies that were developed and adopted for use in Indonesia include:

1. *Ecologically based rodent management (EBRM)* is a set of practices at the community level, including the setting up of a simple trapping mechanism, to control rat infestation in rice fields. It increases mean yields by 5–6% while reducing yield losses due to rat infestation by 33–50%. This practice is now being promoted among farmers in lowland rice agroecosystems in Indonesia.

2. *Site-Specific Nutrient Management (SSNM)* is an approach for improving nutrient management in rice through better targeted applications of fertilizer in terms of amount and timing. It is a field-specific approach that enables farmers to tailor-fit nutrient management to the specific conditions in their respective fields and provides a framework for best management practices for rice. Some of the tools used to facilitate the adoption of SSNM principles are the leaf color charts (LCC) for N management, the *Pemupukan Hara SpesifikLokasi* (PHSL) *Padi Sawah*, and the Nutrient Manager decision tool.

   The LCC is a strip of plastic with different shades of green ranging from light green to dark green that can help farmers determine whether or not the plant should be given nitrogen (N) fertilizer and how many doses need to be given. The shade that is closest to the color of the sample leaves corresponds to a prescribed dosage and timing of N application. It has been shown that this tool can reduce the amount of fertilizer by as much as 15–20% of the dose that is commonly applied by farmers, without lowering the yield. From 1998 to 2012, a total of 148,432 LCCs were distributed in Indonesia.

A leaf color chart

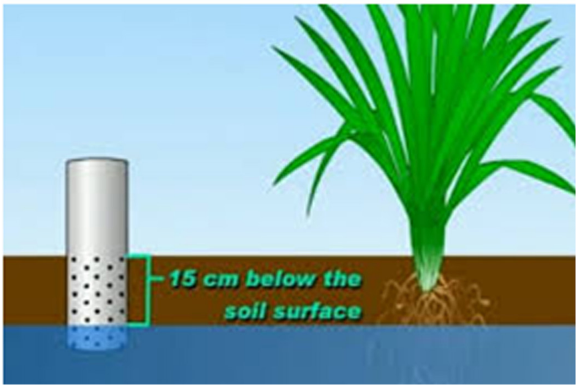
The PHSL Padi Sawah is another tool for SSNM. It is a computer-based decision tool that prescribes an amount of fertilizer to be applied in particular periods during crop growth, depending on the information a farmer or an extension worker inputs into the program regarding conditions on a farm. The program was launched in Indonesia by the Minister of Agriculture in January 2011 and is available at: http://webapps.irri.org/nm/id. Numerous evaluations in farmers' fields across Indonesia have shown that farmers who followed its recommendations were able to match or exceed the yields of those who did not, while reducing fertilizer use. They were also able to reduce their use of pesticides and herbicides since reduced levels of fertilizer leads to fewer incidences of disease and pests associated with high crop absortion of N. The tool, therefore, increases the incomes of farmers following its recommendations.

The Pemupukan Hara SpesifikLokasi (PHSL) was launched on 20 January 2011 in Jakarta by the Ministry of Agriculture of Indonesia. In attendance were, (*from left to right*), Dr. Roland Buresh, IRRI scientist; Dr. Achim Dobermann, former IRRI deputy director general for research; IRRI, Dr. Suswono, minister of Agriculture, Indonesia; Dr. Grant Singleton, IRRI scientist; and Dr. Haryono, IAARD director general.

ICRR/IAARD plans to upgrade PHSL into an ICT-based tool. The upgrade includes: (a) updates in nutrient management identified through research and (b) best rice management practices of IAARD.

3. *Alternate wetting and drying (AWD) technology* is a water-saving technology farmers can apply to reduce their irrigation water use in rice fields without yield penalty. In AWD, irrigation water is applied a few days after the disappearance of the ponded water so the field is alternately flooded and nonflooded. This technology reduces water use by up to 30% and methane gas emissions by 48% without affecting yield. With the efficient use of N and application of organic inputs to dry soil, it can even reduce emissions even further, enhance nutrient efficiency, and reduce insect infestation.

AWD technology is one of the more "mature" IRRC technologies with evidence of widespread adoption in several countries. In Indonesia, AWD has been adopted by the Directorate General of Food Crops as a component of the Integrated Crop Management (ICM) technology package being promoted among rice farmers through farmer field schools.



In the AWD technology, a tube is embedded in the rice field to determine the availability of water in the field. The field is irrigated again only when water level in the tube reaches 15 cm below the soil surface.

4. *The hermetic seed storage (HSS) system* requires the use of containers that are hermetically sealed and, thus, stops the movement of air (oxygen) and moisture between the outside atmosphere and the stored grain. These containers may be special plastic containers (such as the volcanic cube and grain cocoons, both of which are more popularly known as Super Bags) or smaller containers made of plastic, steel or even clay water pots, and can be used for paddy, milled rice, and other cereal crops such as corn.The system controls insect grain pests without using chemicals, protects the grain from rodents, maintains a high seed germination rate, and results in less broken grains during milling compared to open storage systems. Because seeds stored in it have higher germination rates, farmers can use 30–60% less seeds on their farms and sell the rest, possibly at higher prices. It also allows farmers to reduce their storage losses from pests by 2–10%. Finally, because the stored seeds have higher grain quality after milling, farmers can sell surplus seeds for human consumption at prices higher by as much as 30%.

   HSS has been promoted by the Indonesian NARES although adoption has been slow because the price of HSS is too high for some farmers, an inadequate supply of HSS in some regions, and/or farmers do not fully understand its benefits. An effort is underway to promote it among seed farmers, rather than rice producers.

5. *Flatbed dryers (FBD)* reduce drying losses by 50–80%, from a range of 2–6% when using traditional sun drying methods, to about 1% or less. It also maintains the quality of rice grains, thus allowing farmers to earn a 30% price premium over sun-dried paddy. The facility likewise increases milling yield by 2.5%.

   In 2003, a rice husk-fired dryer with a 3.3-ton capacity was developed by the Indonesian Center for Rice Research in Sukamandi, and introduced in South Sumatra by the Assessment Institute for Agricultural Technology. IRRI provided a bigger and more efficient fan to a local manufacturer in Palembang as a grant. This improved rice husk-fired dryer became the prototype for local workshops in the area. By 2010, around 200 dryers had been installed in South Sumatra, mainly by rice millers. Four local workshops are now producing dryers there, with one shop in Palembang already making good-quality dryers. In 2012, IRRI provided additional training on blower testing and manufacturing of an improved rice husk furnace.

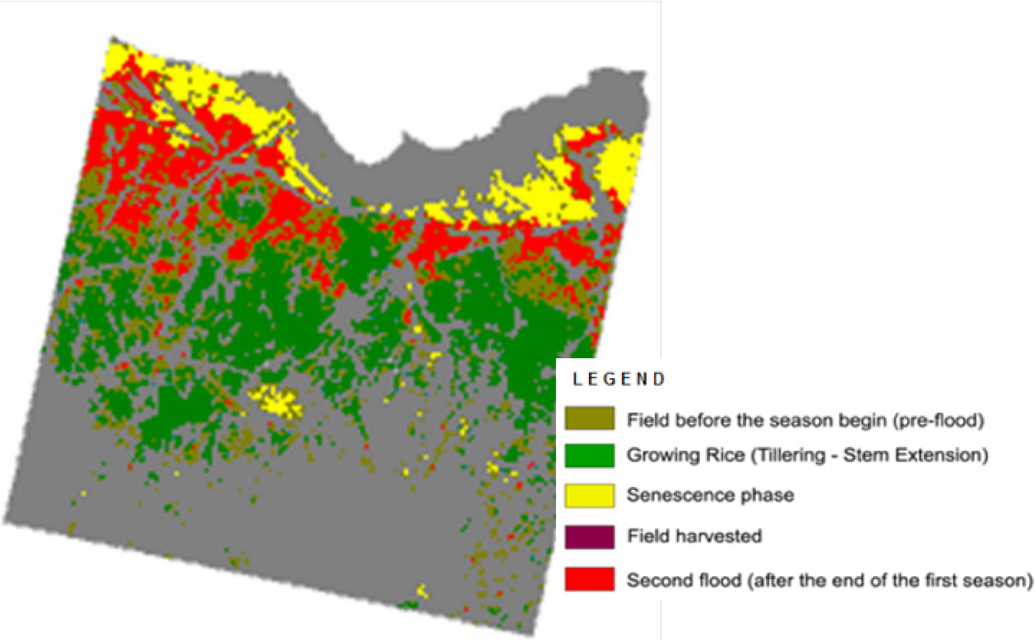
6. *Community seed banks (CSB) or* Membangun Sistem Perbenihan Berbasis Masyarakat. Under CURE, IRRI and its partners have developed the CSB technology, under which a farming community or a group of farmers establishes a scheme or collective system of producing and then exchanging or selling good quality seeds, particularly of indigenous varieties, especially in times of disaster or seed shortages. CSB members properly store the seeds, lend the seeds to other members for free on condition that the borrower returns twice the amount of seeds he or she borrowed, and keeps records of these transactions. They also, and as importantly, promote traditional agricultural practices by monitoring the farming methods of members who contribute to the seed bank and ensuring that they employ traditional and organic farming, thus ensuring the purity of the seeds. They are, therefore, trained in seed selection and storage techniques. In this manner, CSBs not only reduce farmers' dependence on seed companies but also help conserve the agrobiodiversity of villages.

   A model CSB is now being promoted across Indonesia through the *1000 villages independent seeds* project of the government. A manual of operation for this technology had been developed and is being distributed to the Indonesian Center for Rice Research (ICRR) and to the Assessment Institute for Agricultural Technology (AIATs) in 33 provinces. The manual serves as a reference for extension officers in training key farmer-leaders and communities interested

in producing quality rice seeds in upland, rainfed, and swampy areas through CSBs.

Two projects are now being implemented to design tools that will help conceptualize and carry out better production plans at the farm, community, region, and national levels. One of these is the IRRI-Japan project on Climate Change Adaptation in Rainfed Rice Areas (CCARA). Launched in 2010, CCARA aims to develop a decision support system for rainfed lowland rice production based on a seasonal weather forecast. The system, called the *WeRise (Weather-Rice-Nutrient Integrated Decision Support System)*, is designed to allow farmers to obtain crucial weather information that affects rice production, such as the start and end of the rainy season and rainfall distribution patterns, particularly during the crop season. This system also provides an advisory that will help farmers plan sowing and transplanting time, choose appropriate rice varieties, and efficiently apply fertilizer and other inputs. The WeRise prototype is now ready for field testing with partners in Indonesia, Lao PDR, and the Philippines.

The other project is the Remote sensing–based Information and Insurance for Crops in Emerging economies (RIICE), which has been implemented in Indonesia since 2012. The RIICE project aims to reduce the vulnerability of smallholding



Phenological stage of rice crop growth at Subang District, West Java-Indonesia, based on multi temporal analysis of CSk SAR data of November 2013 to April 2014.

rice farmers to pests and diseases, floods, and drought resulting from climate change through the use of remote sensing technology particularly the use of high resolution synthetic aperture radar (SAR) data. Its goal is to increase rice production in the long run by allowing better access to information on the actual growth status of rice crops and expected yields, thus allowing farmers to manage land and other resources better. The same information could be used by decision makers to strengthen food security in the country.

Result area 3. Enriched capacity of Indonesian rice scientists and researchers

From 1963 to 2012, IRRI provided grants for the training and education of 1,029 Indonesian scientists, researchers, program and project managers, and policy makers in various aspects of rice production, handling, and marketing, and the management of rice resources. Most of these grantees (80.3%) participated in short-term courses while 12.1% of them were on-the-job trainees. Thirty-two were PhDs while 41 earned their master's degrees under an IRRI scholarship. The rest were fellows and interns (Table 7). These grantees had become leading scientists, program and project managers, and policy makers who have led and continues to lead the rice production effort of Indonesia. Annex 2 lists the Indonesian scientists and researchers currently working at IRRI, as well as the Indonesian experts who served as members of the Institute's Board of Trustees.

Table 7. IRRI grantees from Indonesia, 1963 to 31 December 2004 and January 2005-December 2012.

Category	1963 to 31 Dec 2004	Jan 2005-Dec 2012	Grand Total
Fellow	0	2	2
Intern	1	2	3
MS	37	4	41
On-the-job trainee	114	11	125
PhD	29	3	32
Short-term course participant	747	79	826
Total	928	101	1,029

Source: IRRI HQ.

The partnership in the years to come

Future challenges in rice production for Indonesia

In the short and medium terms, Indonesia is expected to continue to grapple with producing enough rice for its growing population. When the Dutch government held a population census in 1930, Indonesia had 60.7 million people. In 1961, when it conducted its first census after its independence, its population was 97.1 million people, more than a 30-million increase from what it had three decades before. Its population then was 119.2 million in 1991, 205.1 million in 2000, and 237.6 million in 2010. Although its growth will be tempered by achievements in population management, Indonesia's population is estimated to reach 400 million in 2050. Demand for rice will then amount to 55 million tons, equivalent to 91 million tons of dry unhusked paddy.[2]

[2]BPS. 2010. *Hasil Sensus Penduduk 2010*. Data agregate *per provinsi*. Center Bureau of Statistics Indonesia.

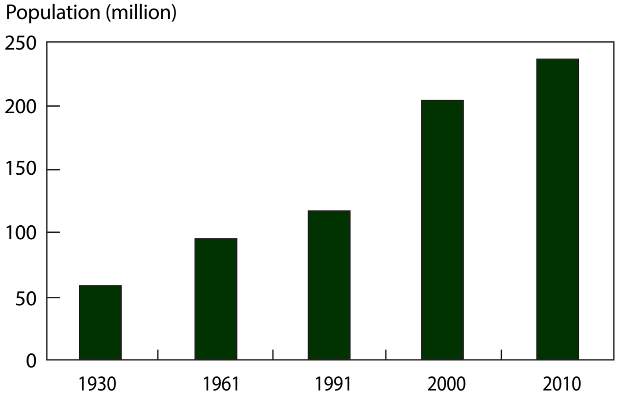


Figure 6. Indonesia's population, 1961-2010.

Adding to the pressure of an increasing population will be the increasing demand from an expanding middle class created by the country's strong and steady economic growth in recent years. Indonesia rose to the status of a lower middle income country in 2009 and achieved a reduction in overall poverty, from 17% in 2004 to 13% in early 2010.[3] Its economy grew by 5.8% in 2013 and 5.01% in 2014.[4] Its per capita gross national income doubled in just 10 years, had been steadily rising from $2,200 in 2000 to $4,500 in 2011. This pace of economic growth is expected to continue over the short-and medium-term.

Indonesia's efforts to provide enough rice for its people will be hampered by the effects of climate change, persistent conversion of agricultural land to other uses, and lack of competent extension workers, and the continued erosion of farmers' incomes.

Indonesia is particularly vulnerable to the negative effects of the El Niño phenomenon, which can drastically reduce the area planted to rice, even in irrigated systems, as lower rainfall means less water available for irrigation. More specifically, the phenomenon causes (1) changes in rainfall patterns and climatic extremes which, in turn, cause floods and droughts; (2) increases in air temperature which, together with humidity and intensive rainfall, cause highly weathered soil that is prone to erosion; and (3) increases in sea level, which increase soil salinity in affected areas.

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[3]*The Jakarta Post*. 2013. RI gets FAO award for reducing hunger. www.thejakartapost.com/news/2013/06/18/ri-gets-fao-award-reducing-hunger.html. June 18 2013.

[4] Source: World Bank. www.worldbank.org/en/publication/global-economic-prospects/data?variable=NYGDPMKTPKDZ&region=EAP.

Moreover, Indonesia does not have enough highly qualified and educated extension workers. At present, it only has 58,123 extension workers, enough to cover only 80% of its 72,143 villages. This limited extension capability will clearly weaken the dissemination and adoption of technologies designed to increase yields and reduce losses, while ensuring the sustainability of agricultural resources.

Finally, farmers' incomes are being eroded primarily due to the farmers being price takers. They are forced to sell unprocessed paddy at harvest time because of their indebtedness to traders, lack of access to storage and processing facilities, and lack of market information. Farmers also face a shortage of rural labor, thus decreasing their ability to produce rice efficiently. They have very limited landholdings, with an average farm measuring less than 1 ha. This prevents them from taking advantage of economies of scale that leads to lower production costs. Low income hinders the ability of farmers to invest in yield-raising and postharvest technologies, thus consigning them to a spiral of poverty.

Areas for future collaboration

Over the short and medium terms, the government of Indonesia and IRRI will continue to move forward to areas of collaboration that have been proven to result in optimal synergies of each partner's strengths. These areas are collaborative research and capacity building.

In response to the challenges that Indonesia faces in pursuing rice self-sufficiency, the Indonesia-IRRI partnership will focus on developing more and better varieties that can withstand problems brought about by climate change, such as salinity, drought, flood, and pest and insect infestation, which limit rice area expansion in, and attainable yields from, marginal areas. Through this partnership, Indonesia and IRRI will work together to develop varieties that are fortified with micronutrients that will reduce, if not eliminate, conditions and diseases associated with malnutrition, especially among women and children who are most vulnerable. Lastly, each partner will focus on developing varieties that require minimal amounts of input without affecting yield, thus reducing the production cost and increasing the net income of farmers.

These efforts, most of which are ongoing, will be supplemented through collaborative research and continued education and training of Indonesian scientists and researchers in the field of rice science.

In an Indonesia-IRRI workplan meeting, held in January 2011 in Jakarta, participants agreed that for the next four years (2011-2014), focus areas would include:

1. Support to the Indonesian rice production program
    a. Varietal development to mitigate the effects of, and adapt to climate change, particularly to enhance tolerance of abiotic stresses such as submergence, drought, salinity, and low temperature damage in high elevation areas;
    b. Formulation of a national strategy and framework plan for hybrid rice development;
    c. Implementation of integrated crop, pest, and resource management in the target areas through the IRRC, CURE, and other fora; and
    d. Dissemination of proven NRM technologies, including postharvest technologies.
2. Collaborative research
    a. Improving livelihoods for, and lowering poverty incidence among, poor rice farmers in Indonesia and in South and Southeast Asia through CURE;
    b. Various areas of interest of the Hybrid Rice Development Consortium;
    c. Areas of interest of Phase IV of the IRRC such as site-specific nutrient management, weeds and rodent management (including rodent fertility control studies), and water and postharvest management;
    d. Evaluation of Green Super Rice inbreds and hybrids under rainfed and irrigated conditions;
    e. Selection of a Golden Rice transformation event for the introgression into local rice varieties and releases to farmers and consumers;
    f. Genetic and environment interaction of zinc content in rice grains;
    g. Management of rice virus diseases in Java (including BPH management);
    h. Climate change adaptation for rainfed rice areas;
    i. Improved tolerance of drought through phosphorus acquisition;
    j. Development of high-yielding cytoplasmic male sterile (CMS) lines for seed production;

k. Strengthening linkages between research and development initiatives to accelerate delivery and impact of technology through farmer field school systems, information and communication technologies (Rice Knowledge Bank), and other appropriate and relevant capacity building measures;
l. Rice price fluctuations and their impacts on rural poverty in Indonesia; and
m. Socioeconomic policy research.

3. Capacity building and development
   a. Scholarships for degree programs on identified priority disciplines using various models;
   b. Short course training including training of trainers for middle level technicians, scientists, and experiment station managers;
   c. On-the-job training, internships, and in-country training;
   d. Continued implementation of the shuttle scientist program; and
   e. Joint publication of research activities and outputs.

Annex 1

Varieties released in Indonesia and IRRI contribution to their parents, 1980-2012.

No.	Variety	Year released	Origin	Cross
1	Cimandiri	1980	B2791b-Mr-257-3-2	Pelita I-1/B2709
2	Cisadane	1980	B2484B-PN-28-3-MR-1	Pelita I-1/B2388
3	IR42	1980	IR2071-586-5-6-3-4	IR2042/CR94-13
4	PB-50	1980	IR9224-117-2-3-3-2	IR2153-14-1-6-2/IR28// IR2070-625-1
5	Semeru	1980	IR2307-247-2-2-3	CR-13/IR1561-228-3-3
6	Ayung	1980	B2484b-Pn-28-3-Mr-5	Pelita I-1/B2388
7	Batang Agam	1981	B2983b-Sr-13-4-1-5	Sirendah Merah/ IR2153-153-1-4
8	Cipunegara	1981	B2498d-Pn-76-8	Pelita I-1/B2393
9	Krueng Aceh	1981	B2791b-Mr-196-2-3-3-20	Pelita I-1/B2709
10	PB-52	1981	IR5853-778-5	Nam Sa Gui 19/IR2071-88//IR2061-214-3-6-20
11	PB-54	1981	IR5853-162-1-2-3	Nam Sa Gui 19/IR2071-88//IR2061-214-3-6-20
12	Barito	1981	B2489d-Pn-1-76-8	Pelita I-1/B 2393
13	Bahbolon	1983	IR15529-253-2-2	IR2035-117-3/IR2061-522-6-9//IR2307-64-2-2
14	Bogowonto	1983	B5323b-Pn-17	B2791//PB36/PB36/// PB36
15	Citanduy	1983	IR5657-33-2-2-3	IR2006/IR2146//IR2061/ IR2055
16	IR46	1983	IR2058-78-1-3-2-3	IR1416/IR1364//IR1366/ IR1539
17	Kelara	1983	MHM 28 (IR13543)	R. Heenati/IR3403// IR34
18	PB-56	1983	IR13429-109-2-2-1	IR4432-52-33//Ptb33/ IR2071-625-1-252
19	Porong	1983	B5323b-Pn-11	B2791b-Mr-134-1-3/ PB36//PB36///PB36
20	Sadang	1983	M61b-112-34-M-6	B459b-Pn-132-9-3/IR2071-588-5-6
21	Sentani	1983	S55c-31-2	IR2061-464-2/SR887// IR2053-521-1-1
22	Singkarak	1983	S263b-37-2-4	C22/IR36
23	Batang Ombilin	1984	B2980b-Sr-2-6-2-3-2	Kuning Galung/IR2061-714-3-8-7
24	Cikapundung	1984	S268b-58	Pelita I-1/IR2071
25	Ranau	1984	B3622f-Tb-14-2	IR8/Dawn//Si Ampat/ Arias

No.	Variety	Year released	Origin	Cross
26	Kapuas	1984	B2791b-Mr-196-2-3-1-3	Pelita I-1//CR94-12/IR20
27	Batang Pane	1985	B5322b-Pn-19-Ms-27-Kp-1	B2791b-Mr-134-1-3/PB36
28	Cimanuk	1985	S287b-39-1-3	IR4422-98-3-6/IR3352-38-3-1
29	Cisanggarung	1985	B4363e-Kn-7-0-0-2	IR2061-288-3-9/Pelita I-1//PB36///Pelita I-1
30	Cisokan	1985	B4070D-PN-199-43	PB36/Pelita I-1
31	Progo	1985	B3897-3d-Pn-56	IR2071/Pelita I-1// B981/Pelita I-1
32	Tajum	1985	IR4744-128-2-3-4-ck-4	RPW 6-13/IR1721-11-6-8//IR20610464-2
33	Tuntang	1985	B5322b-Pn-1-Ms-1-Kp-1	B2791b-Mr-134-1-3/ IR36
34	Maninjau	1985	B3016b-Tb-3-2-1-1-3	IR8/Sintha//G. Lampung///Short Sigadis/Sintha//Tabente Mainti
35	IR48	1986	Ir4570-83-3-3-2	IR1702-74-3-2/IR1721-11-6-8-3//IR2055-48-1-2
36	IR64	1986	IR18348-36-3-3	IR5657/IR2061
37	IR65	1986	IR21015-196-3-1-3	Batatais/IR36//IR52
38	Nagara	1986	IR11141-6-1-4	IR2061-465-1-5-5/Leb Mue Nahng III
39	Tapus	1986	IR11188-B-B-118-1	IR36/Leb Mue Nahng III
40	Alabio	1986	SPR 7232-2-3-1-0	Leb Nue Nahng III/IR8
41	Dodokan	1987	IR28128-45-3-3-2	IR36/IR10154-2-3-3-3//IR9129-209-2-2-2-1
42	Jangkok	1987	IR19743-46-2-3-3-2	IR9129-192-2-3/ IR10176-79
43	Danau Bawah	1987	B3906f-13-13-St-37	B2714b-Pn-8//IR32//Arias/IR36
44	Ciliwung	1988	B4183B-PN-33-6-1-2	IR38//2*Pelita I-1-2/IR4744-128-4-1-2
45	Batur	1988	-	IR3380-13-17/IR5853-162-1-2-3
46	Musi	1988	-	SML Tomarin/Pelita I-1/IR3351-38-3-1/IR36
47	Batang Sumani	1989	IR26110f-Sr-4	Pratao//IR3351-38/IR36
48	IR 66	1989	IR32307-107-3-2-2	IR13240-108-2-2-3/IR9129-209-2-2-2-1
49	IR 70	1989	IR28228-12-3-1-1-2	IR19660/IR5853// IR98228

No.	Variety	Year released	Origin	Cross
50	IR 72	1989	IR35366-90-3-2-1-2 (IR72-Mr-1)	IR19661/IR15795// IR9129
51	Walanai	1989	B4368f-Mr-13-3 (GH274)	Pelita I-1//B3663/ Pelita I-13//IR38
52	Way Seputih	1989	B6216-Mr-9-3-3 (GH705)	Cisadane4/IR36
53	Lusi	1989	B4183h-Kp-1	IR38/Pelita I-1// IR4744/ Pelita I-1
54	Poso	1989	-	IR9093-195-1/C22
55	Danau Laut Tawar	1989	B5526f-St-17	Seratus Malam/IR50
56	Barumun	1991	-	Ptb 33/*4 IR3043
57	Cenranae	1991	GH-GRM-1 (BR319-1-HR38-M-1)	IR5 (D)/BIPLAB introduksi dari IRRI
58	IR 74	1991	IR32453-20-3-2-2-M-1	IR19661-131-1-2/ IR15795-199-3-3 introduksi dari IRRI
59	Lariang	1991	GH-GRM-4 (B5960-Mr-B5-10-M-1)	Cisadane3/IR36E
60	Danau Tempe	1991	-	IR83/Carreon/B981k
61	Lematang	1991	-	IR25074/IR46//Ayung
62	Sei Lilin	1991	-	IR36/LMN III
63	Bengawan Solo	1993	B7136e-Mr-22-1-5	IR56/IR8411
64	IR68	1993	IR28224-3-2-3-2	IR196600/IR2415/IR54
65	Way Rarem	1994	-	IR83/Carreon/B981k
66	Batang Anai	1996	B7959f-KN-14-2	IR54742/IR64
67	Cilosari	1996	1647/PSJ	mutan SM-268/PSJ/ IR36
68	Digul	1996	S2961E-KN-8-3-2	IR19661/IR64/IR19661
69	Maros	1996	B8049F-MR-10-2	Markoti/IR64
70	Cirata	1996	S382B-2-2-3	IR9129-159-3/IR5975
71	Banyuasin	1997	87810Ff-KN-13-1-1	Cisadane/ Kelara (IR13543)
72	Lalan	1997	-	Barito/IR54/IR9575/IR54
73	Way Apo Buru	1998	S3383-1d-Pn-16-2	IR18349-53-1-3-1-3/ IR19661-131-3-1// IR19661-131-3-1-3/// IR64////IR64
74	Ketonggo	1999	B8583 E-MR-87-1-1	Persilangan B82128 (B4183E-KP-1/ IR28224 //B4183)
75	Limboto	1999	TB47H-MR-5	Papah Aren/ IR36//Dogo

No.	Variety	Year released	Origin	Cross
76	Towuti	1999	S3385-5E-16-3-2	S499B-28/ Carreon//2*IR64
77	Batanghari	1999	B7812F-KN-14-1	Cisadane/IRR19661-131-1-3-1-3
78	Dendang	1999	IR52952-B-B-3-3-2	Osok/IR5657-33-2 (introduksi dari IRRI)
79	Bondoyudo	2000	IR60819-34-2-1 (HD174)	IR72/IR48525-100-1-2
80	Celebes	2000	IR31892-100-3-3-3-3	Persilangan tetap/IR2415-90-4-3-2// IR19661-131-1-2
81	Ciherang	2000	S3383-1d-Pn-41-3-1	IR18349-53-1-3-1-3/3*IR19661-131-3-1//4*IR64
82	Cisantana	2000	B7974F-MR-2-2-2	IR64/IR54742-1-19-11-8
83	Kalimas	2000	IR59552-21-3-2-2 (HD176)	PSBRC2/IR39292-142-3-2-3
84	Tukad Balian	2000	IR59682-132-1-1-1-2	IR48613-54-3-3-1/ IR28239-94-2-3-6-2
85	Tukad Petanu	2000	IR 69726-116-1-3	IR52256-84-2-3/ IR72//2*IR1561-228-3/Utri Merah
86	Tukad Unda	2000	IR68305-8-1	Balimau Putih/4* IR64
87	Indragiri	2000	B7952F-KN-18-2	B6256-MR-3-5P/ Barumun/Rojolele/IR68
88	Angke	2001	Bio 8-BC5-MR-3-5-2-PN-1	IR64*6/IRBB5
89	Batang Gadis	2001	B9307E-MR-17	IR64/NDR308//IR64
90	Ciujung	2001	B10177B-MR-2-2-1	IR64/RP1837-715-3-2
91	Conde	2001	Bio 9-BC5-MR-4-5-KN-5-1	IR64*6/IRBB7
92	Konawe	2001	S3382-2d-Pn-16-3	S487b-75/IR19661-131-3-1//IR19661///IR64////IR64
93	Singkil	2001	S3254-2g-21-2	IR35432-33-2/IR19661-131-3-1//Ciliwung///IR64
94	Wera	2001	B8974B-MR-7	Hawara Bunar/4*IR64
95	Cimelati (semi PTB)	2001	B10384-Mr-1-8-3	Memberamo//IR66160/ Memberamo
96	Silugonggo	2001	IR39357-71-1-1-2-2	IR9129-209-2-2-2/ IR19774-23-2-2//IR9729-67-3
97	Siak Raya	2001	B9709f-Kn-29-2-3	Batang Ombilin/ Kelara (IR13543)

No.	Variety	Year released	Origin	Cross
98	Air Tenggulang	2001	B7809D-KA-137	Batang Ombilin/Siam 29// Batang Ombilin (Batang Ombilin: Kuning Galung/ IR2061-714-3-8-7)
99	Lambur	2001	B9860C-KA-1	Cisadane/IR9884-54-3
100	Sunggal	2002	S3382-3F-3-1-3	S487b-75/IR19661// IR19661///IR64////IR64
101	Batang Lem-bang	2003	S4362F-Kn-2-1-2	Sintha/IR64//IR64
102	Batang Piaman	2003	SPR85163-5-1-2-4	IR25393-57/RD203// IR27316-96/// SPLR7735/ SPLR2792
103	Cibogo	2003	S3382-2D-PN-16-3-KP-1	S487B-75/IR19661-131-3-1//IR19661-131-3-1/// IR64////IR64
104	Cigeulis	2003	S3429-4d-Pn-1-1-2	Ciliwung/Cikapundung// IR64
105	Pepe	2003	B8971B-15	Cimariti/IR64//IR64/// IR64////IR64
106	Setail	2003	B10299B-Mr-116-2-3-5-1	IR65/B8203B-Mr-1-17-1
107	Ciapus (semi PTB)	2003	B10386E-Kn-36-1	Memberamo//IR66154-521-2-2/Memberamo
108	Mekongga	2004	S4663-5d-Kn-5-3-3	A2790/IR64//IR64
109	Ciasem	2005	B10299B-MR-116-2-4-1-2	IR65/B8203-MR-1-17-1
110	Inpari-5, Mer-awu	2008	IR65600-21-2-2	SHEN NUNG 89-366/Ketan Lumbu
111	Inpara-3	2008	IR70213-9-CPA-12-UBN-2-1-3-1	IR69256/IR43524-55-1-3-2
112	Inpari 8	2009	IR73012-15-2-2-1	IR68064-18-1-1-2-2/ IR61979-136-1-3-2-2
113	Inpari 9 Elo	2009	IR73005-69-1-1-2	IR65469-191-2-2-2-3-2-2/ IR61979-136-1-3-2-2
114	Inpari 10 Laeya	2009	S3382-2d-Pn-4-1	S487b-75/ IR19661// IR19661/// IR64////IR64
115	Inpara 5	2009	IR07F101	IR07F101 (=IR64 Sub-1)
116	Inpara 6	2009	B10528F-KN-35-2-2	IR64/IRBB21//IR51672
117	Inpari 11	2010	BP1178-2F-26	Cisadane/IR54742-1-19-11-8
118	Inpari 12	2010	OM2395	IR63356-SEL/TN1
119	Inpari 13	2010	OM1490	OM606/IR18348-36-3-3

No.	Variety	Year released	Origin	Cross
120	Inpara 4	2010	IR05F101	IR05F101 (=Swarna Sub-1)
121	Inpari 13	2010	OM1490	OM606/IR18348-36-3-3
122	Inpago 7	2011	B12498E-MR-1	IR68886/BP68//Slegreng///Maninjau/Asahan
123	Inpari 15 Parahyangan	2011	BP3244-2E-8-8-3-3-1*B	TB168E-TB-4-0-1/Widas//IR64
124	Inpari 17	2011	B10531E-KN-15-2-0-LR-B378-2	Bio9-MR-V3-11-PN-5//IR64*3/ IRBB21
125	Inpari 20	2011	BP2080-2E-KN-6-1	S2823E-KN-33/IR64//S2823E-KN-33
126	Inpari 22	2012	BP3300-2C-2-3	IR42/IRBB5//Ciherang///Towuti
127	Inpari 25 Opak Jaya (Ketan merah)	2012	BP1002E-MR-2	BIO 530C-MR-1/IRBB 21
128	Inpari 26	2012	Barkat (K78-13)-KN-B	Shinei/China 971
129	Inpari 27	2012	87025-TR973-3-1-1-KN-B	BALDO/7904-TR4-4-2-1-1
130	Inpari 28 Kerinci	2012	RUTTST85B-5-2-2-2-0-J	IR 63872-14-2-2-1/CEA-1
131	Inpari 29 Rendaman	2012	B13138-7-MR-2-KA-1	IR69502-6-SKN-UBN-1-B-1-3/KAL9418F//Pokhali/Angke
132	Inpari 30 Ciherang Sub 1	2012	IR09F436	Ciherang/IR64sub1/Ciherang

Annex 2

Indonesians in IRRI

I. **Indonesians on the IRRI Board of Trustees**

The IRRI Board of Trustees is comprised of prominent experts from various countries who play an important role in directing strategy to be taken by IRRI's top management. Since the 1970s, nine Indonesian experts have received the honor to be members of the Board. These are the distinguished Indonesians and their respective years of service:

Prof. Dr. Tojib Hadiwidjaja	1970–73
Prof. Dr. Gunawan Satari	1974–77
Mr. Sadikin Sumintawikarta	1978–83
Prof. Dr. Ida Nyoman Oka	1984–89
Prof. Dr. Ibrahim Manwan	1990–95
Prof. Dr. Sjarifuddin Baharsjah	1996–2001
Dr. Achmad M. Fagi	2002–07
Prof. Dr. Achmad Suryana	2008–13
Prof. Dr. Tahlim Sudaryanto	2014–to present

In late 2000, Prof. Dr. Sjarifuddin Baharsjah was the first Indonesian to be elected as the chair of the Board.

II. **Indonesian experts at IRRI HQ**

Dr. Endang Septiningsih

Endang Septiningsih is a molecular geneticist and breeder in abiotic stress tolerance. She is mainly responsible for developing varieties that are suitable for anaerobic direct seeded rice (ADSR) conditions in both rainfed and irrigated rice ecosystems.

Dr. Septiningsih leads the ADSR breeding program at IRRI, whose main focus is on developing varieties that combine tolerance of flooding during germination (referred to as anaerobic germination) and good early seedling vigor, among other traits. Her team has also been focusing on identifying QTLs and genes from several highly tolerant donors that enable rice to germinate in anaerobic conditions. This will provide the essential tools for understanding the different molecular mechanisms underlying tolerance and breeding for direct-seeded varieties that can survive flooding during germination.

Dr. Septiningsih also serves as an adjunct associate professor in the Crop Science Cluster of the College of Agriculture at the University of the Philippines Los Baños.

Dr. Inez Slamet-Loedin

Inez Slamet-Loedin, a molecular biologist, and the head of the IRRI Genetic Transformation Laboratory. Her work aims to help 2 billion women and children who are affected by micronutrient deficiency, also known as "hidden hunger." She leads a team that develops healthier rice, particularly high-iron and zinc-rich rice. Iron-rich rice has the potential to prevent iron-deficiency anemia that afflicts more than 1 billion people globally, particularly poor women and children. Iron deficiency and iron-deficiency anemia contribute to increased maternal mortality, stifle children's cognitive and physical development, and reduce people's energy.

Dr. Slamet-Loedin is also leading IRRI's efforts to identify useful drought-tolerance genes that could lead to the development of either GM or non-GM drought-tolerant rice. She leads one other project on GM rice.

Dr. Buyung Hadi

Buyung Hadi, an entomologist and plant pathologist, is currently, leading an entomology research group at IRRI. Dr. Hadi and his team focus their efforts in unraveling the arthropod ecology of rice ecosystems and translating the gained insights into novel pest management strategies. His work includes an exploration of natural repellents as a pest management option of herbivorous hemipterans, the effects of sublethal dose application of insecticides on pest populations, and the potential of introducing entomopathogenic fungi as rice plant endophytes.

Dr. Kurniawan Rudi Trijatmiko

Kurniawan Rudi Trijatmiko is a molecular geneticist. He graduated from Wageningen University, the Netherlands. He joined as a postdoctoral fellow and then rejoined as a project scientist in Dr. Slamet-Loedin's group at IRRI. He is involved in the development of iron-rich rice, molecular characterization of Golden Rice and genetically engineered drought-tolerant rice, development of precise genetic engineering tools in rice, and validation of gene cloning using transgenic rice. He has been involved in the collaboration projects between IRRI and the Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development, such as genetic mapping for blast resistance and drought tolerance in rice and marker-assisted selection for improving yield potential in rice.

III. **Personnel at the IRRI office in Indonesia**

IRRI's office in Indonesia helped build a stronger partnership between IRRI and the Indonesian government resulting in improved rice production in the country. This was made possible by the men and women who contributed their expertise and insights in putting forward the goals of the Institute closer to its national research and extension partners through the years. The current staff members of the Office are:

Prof. Dr. Zulkifli Zaini, IRRI representative and liaison scientist

M. Surya Edy, assistant manager

Diah Wurjandari, assistant researcher

Agus Mahardika, office assistant/driver

For more on Indonesia-IRRI partnership, scan the QR code above with your mobile device or visit: http://irri.org/our-work/locations/indonesia.