

The Japan Rice Breeding Project

Summary of achievements and future directions

The Japan Rice Breeding Project (JRBP) has contributed greatly to food security in countries where poverty is prevalent and the risk of food shortage is high.

Support from the Policy and Human Resources Development Fund, a partnership between the Government of Japan and the World Bank, has helped modernize the breeding programs of IRRI and the Africa Rice Center (AfricaRice) to develop new varieties that meet some of the most pressing needs of the poorest rice farmers and consumers in the world.

Improved rice varieties

New rice varieties were developed for various ecosystems—including irrigated, rainfed lowland, upland, and high elevation—and released in Asia and sub-Saharan Africa (SSA) over the last 5 years. These varieties are showing increase in grain yield over current farmers' varieties. They are also stabilizing productivity as these are better adapted to local diseases, pests, and environmental stresses than older varieties.

- JRBP released more than 35 varieties: 9 each for upland and lowland environments and 16 varieties for irrigated systems in SSA.
- Through the JRBP, IRRI has released 5 improved rice varieties in Burundi, Mozambique, and Tanzania over the past 2 years. These varieties yield between 6.5 and 7.4 tons per hectare.

- 88 new stress-tolerant varieties have been developed for Bangladesh, India, Indonesia, Myanmar, Nepal, the Philippines, and Vietnam.

Faster ways to breed better varieties

Through JRBP, key research support facilities for rice breeding were upgraded, enabling great progress in breeding work.

- SNP (single nucleotide polymorphism) genotyping facilities such as the 6K SNP Infinium Chip and the Fluidigm platforms were established to enable marker-aided breeding.
- Breeding lines carrying genes for tolerance of multiple stresses prevailing in SSA were developed and shared with partners. These include elite lines that tolerate both flooding and drought in lowlands.
- Genes conferring resistance to major diseases were introduced into pre-breeding lines. Molecular markers were developed to accelerate the introduction of these genes into new varieties.

Multi-parent Advanced Generation Inter-Cross (MAGIC) populations

MAGIC populations are novel genetic resources designed to offer new combinations of genes and traits for breeding. In a multi-location trial, elite entries from MAGIC populations were evaluated at 12 different locations in South and Southeast Asia

MAGIC population field trial in Yezin, Myanmar.





MAGIC population field trial in India.

to identify high-yielding as well as adaptive breeding lines across locations. Analysis will aid identification of better varieties or gene donors for target locations in the region.

Harnessing rice's genetic diversity for the future

The JRBP investment has enabled IRRI and AfricaRice to fully explore the wealth of genetic diversity conserved at the International Rice Genebank for rice improvement. Currently, only 5% of more than 125,000 rice lines in the genebank have been used in breeding. Rice scientists can apply new technologies to tap into this rich genetic resource. From this pool of diversity, new genes were identified to confer tolerance for multiple stresses. For example, a gene that protects rice from heat stress at the flowering stage was discovered. The gene was then transferred to popular rice cultivars in West Africa (Sahel329), Latin America (Caiapo), and South Asia (Pusa Basmati) using marker-assisted selection.

Training and capacity building

Modernizing rice breeding has resulted in training opportunities that are helping build a new generation of rice scientists and cultivate strong collaborations.

- JRBP has supported 5 masters and 15 doctoral students in Asia and Africa.
- A curriculum for the Rice Breeding Academy was developed that includes genetics, breeding methods, trait pipeline and population development, and seed production for current and future rice breeders.
- Training courses were conducted annually, enabling hundreds of researchers from SSA to build technical knowledge in rice breeding, proper evaluation of breeding materials, and delivery.
- A joint international workshop was held in Tsukuba in March 2015, during which achievements of Japanese collaboration during the past three decades were evaluated and new research areas for future collaboration were identified. The partnership between Japanese and CGIAR scientists was also strengthened in line with the Rice Global Rice Science Partnership (GRISP).

International Rice Research Institute (IRRI)

The International Rice Research Institute (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. IRRI is an independent, nonprofit research and educational institute founded in 1960 by the Ford and Rockefeller foundations, with support from the Philippine government. The institute, headquartered in Los Baños, Philippines, has offices in 15 rice-growing countries in Asia and Africa, and about 1,000 staff members.

Working with in-country partners, IRRI develops advanced rice varieties that yield more grain and better withstand pests and disease as well as flooding, drought, and other destructive effects of climate change. More than half of the rice area in Asia is planted to IRRI-bred varieties or their progenies. The institute develops new and improved methods and technologies that enable farmers to manage their farms profitably and sustainably, and recommends rice varieties and agricultural practices suitable to particular farm conditions as well as consumer preferences. IRRI assists national agricultural research and extension systems in formulating and implementing country rice sector strategies.

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Rice science for a better world