ASIA BRIEF

IMPROVING RICE PRODUCTION IN ASIA PARTNERSHIP RESULTS

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EDITORIAL

The Asia Briefing Paper Series aims to inform the development practitioners and the (Swiss) public about new innovations, results and impacts of Swiss development cooperation in Asia. It shall particularly highlight past and present efforts to achieve aid effectiveness through partnerships between Swiss agencies and local partners. Discussion and learning from these experiences shall further enhance our motivation to reduce social exclusion and efforts to half poverty in Asia by 2015 (MDG N° 1).

Walter Meyer, Head East Asia Division

Transplanting rice, Philippines

A REGIONAL APPROACH TO FOOD SECURITY

Rice is the staple food for 2.7 billion people in Asia, providing 40% of their daily calorie intake. Ensuring sufficient supplies of rice that are affordable for the poor has been a challenge for the past 50 years.

In 1997, SDC began funding a regional partnership program between 11 rice-growing countries in South and Southeast Asia and the Philippines-based International Rice Research Institute (IRRI), named the Irrigated Rice Research Consortium (IRRC). The countries involved are Bangladesh, Cambodia, China, India, Indonesia, Lao PDR, Myanmar, Sri Lanka, Vietnam, Malaysia, and the Philippines.

This partnership program has helped to identify and address problems of each country's irrigated rice production by developing and testing rice-growing technologies and crop-management approaches in farmers' fields. The focus is on more efficient use of resources such as land, labor, water, and fertilizer leading to sustained, environmentally friendly increases in production.

Concrete results presented hereafter are being adopted by thousands of farmers across Asia because they are a win-win benefit for farmers in economic and environmental terms.

'Alternate wetting and drying', a water-saving practice, allows farmers to harvest the same yields using 15–30% less water. If this practice is applied across Asia the amount of water saved in 1 year would equal 200 times the water consumption of Paris for 1 year.

'Direct seeding of rice', an alternative to the usual method of transplanting seedlings—saves 20% in labor costs and 30% in water costs. Direct seeded rice matures 10-15 days earlier hence allowing farmers to sow other crops earlier and increasing their flexibility to respond to irregular rainfall.

Post harvest technologies such as improved driers lead to rice milling quality 12–40% higher than that of sun-dried rice. Thousands of farmers are earning more by using special airtight bags to safely store their seeds.

Yield increases from adopting **'site-specific nutrient management'** improved net returns by 100$ to 300$ per hectare per year in China, India, Indonesia, the Philippines and Vietnam. This innovation has led to harmonized national recommendations for nutrient management of irrigated rice affecting millions of farmers in Indonesia, the Philippines and China.

Ecological rodent pest management reduces the use of chemical rodenticides by 50% and increased yields by about 0.5 tons per hectare. Ecological rodent pest management has become the national policy for rodent management in Indonesia, Myanmar, and Vietnam.

THE ROOTS OF RICE PRODUCTION

Throughout history, rice has been one of humanity's most important foods. Around half of the world's population depends on rice for their staple food. Archeological evidence traces the roots of rice to China and India around 3,000 B.C. Rice culture gradually spread westward and was introduced to southern Europe in the medieval times.

After World War II, Asia was desperate for food. At a time when the fear of famine was spreading across Asia, the Ford and Rockefeller Foundations founded the IRRI, a international centre of competence for rice, in Los Banos, Philippines, in 1960. At that time rice was, and still is, the single largest source of food, employment, and income for billions of people, particularly in Asia. The institute was built when the world's population was rapidly increasing while at the same time land for growing rice was steadily decreasing.

With the introduction of IRRI's modern high-yielding varieties in the 1960s, rice yields and overall production rose rapidly. Annual production in Asia increased from only 200 million tons in 1961 to 600 million tons in 2007. The period of growth throughout the 1970s and 1980s has become known as the Green Revolution. By increasing farmers' income and, at the same time, lowering rice prices–and thereby benefiting poor consumers—the Green Revolution directly and indirectly reduced poverty across Asia. The increased calorie intake alone, raised the health status of 32-42 million preschool children in Asia, and significantly decreased child mortality rates.

SDC supports the IRRI with a core contribution, the Asia regional partnership program 'IRRC' and the SDC bilateral rice project in Laos.

CHALLENGES TODAY: THE RICE PRICE CRISIS

Today, there is a call for another Green Revolution. International prices for rice soared from US$400 per ton in January 2008 to more than $1,000 per ton in May 2008. Major exporters Vietnam and India have cut back exports to ensure enough rice for their domestic needs. In some countries, food riots have led to soldiers guarding food trucks to prevent looting.

Many factors, both long- and short-term have contributed to the present crisis. One reason is that the world is consuming more rice than it is producing, rice stockpiles have rapidly been reduced over the past few years. Another reason for this is that annual growth in yield has slowed to the point where it is now lower than population growth.

Reduced public investment in agricultural research and development has contributed to the problem. Many governments believed that the steady decline in rice prices in the 1990s meant that there was plenty of food available and that supply problems had been beaten.

In 10 years, the world will need to produce 50 million tons more than it does now. However, there is little room to expand rice-growing area. Indeed, tens of thousand of hectares of rice fields are lost annually to housing and industrial development.

Weak irrigation infrastructure, recurring pest outbreaks, and extreme weather have also taken a toll on rice production in recent years. Adding to the problem, rising oil and fertilizer prices have made production and transport of rice more expensive. The increase in the price of fertilizers has also led to its reduced use and, consequently, lower yields.

COUNTING ON IRRIGATED RICE

Now that the world is facing almost the same dilemma as it did 4 decades ago—before the Green Revolution—the question is: where do we turn to get more rice? The answer brings us back to Asia, specifically the continent's irrigated lowlands. There are 79 million hectares of irrigated lowlands in Asia, which represent only 45% of the global rice area. However, this is the planet's most productive rice-growing environment, providing 75% of the world's rice. In South Asia, for example, 1 hectare of irrigated rice can feed 48 people, while 1 hectare of rainfed rice can feed only 13.

More than 2.7 billion Asian farmers and consumers depend on irrigated rice for their food. To get through the current crisis and improve livelihoods of people in Asia, yields from the irrigated lowlands must be increased.

Transplanting rice – heavy work

IMPACT OF THE PARTNERSHIP: IMPROVING EFFICIENCY IN RICE PRODUCTION AND REDUCING MAJOR LOSSES

The regional partnership program has helped to identify and address problems of each country's irrigated rice production by developing and testing rice-growing technologies and crop-management approaches in farmers' fields. The focus is on more efficient use of resources such as land, labor, water, and fertilizer leading to sustained, environmentally friendly increases in production.

Partner institutions are national research and extension institutes, which set the research agenda and participate in the research process. Promising innovative technologies are tested in different environments and adapted to local conditions. After validation in farmer's fields, trainers are trained, and manuals developed and translated into local languages. This process allows countries with the same challenges to learn from each other. Through participatory research and extension, the new technologies provide environmentally friendly solutions to increase rice production and therefore help achieve regional food security.

Not all technologies are at the same level of advancement in all countries. Some technologies are still being disseminated while others already have achieved impact.

MORE RICE USING LESS WATER

Water is a precious commodity, with competing demands between water for households, industry, and agriculture. Irrigated rice is estimated to receive 24–30% of the world's freshwater. In Asia, more than 80% of the developed freshwater resources are used for irrigation purposes, mostly for rice production. By 2025, 15–20 million hectares of irrigated rice will experience some degree of water scarcity, and important biodiversity wetlands will suffer from water shortages.

Irrigated lowland rice is usually grown under flooded conditions, and kept continuously flooded to help control weeds and pests. However, researchers found that rice only needs to be continuously flooded at the flowering stage. Using alternate wetting and drying (AWD), a water-saving practice developed by the partnership program, fields are allowed to dry, then are re-flooded, then allowed to dry again. In AWD, rice can be flooded to a lesser extent than usual (to a depth of 3–5 centimeters instead of up to 10 centimeters). Using 15–30% less water, farmers can harvest the same yields. The water saved can be used to irrigate more fields, thus increasing overall production. For example, where there is sufficient water for 80 hectares to flood their fields continuously, 110 hectares could use AWD.

The field water tube is a simlpe toolused in implementing AWD fror deciding when to irrigate fields (Mekong Delta, Vietnam)

After 4 years of research, training of trainers, and dissemination among farmers, AWD is now being practiced by tens of thousands of farmers in China and the Philippines, and is being adopted rapidly by farmers in Vietnam, India, Bangladesh, Myanmar, and Indonesia.

Next to saving water, farmers using AWD also save fuel for running water pumps a considerable saving given the rising cost of fuel. AWD crops, which require less labor, are also 20–25% cheaper to manage.

In the Philippines, where rice shortages are causing major political pressures, some 40,000 farmers are estimated to have adopted AWD since it was introduced in 2006.

If AWD were to be adopted all across the irrigated lowlands of Asia, 200 cubic kilometers of water would be saved. To put this into perspective, 1 cubic kilometer—1 trillion liters—is about how much Paris uses in 1 year. Adopting AWD provides tremendous benefits for the environment and for the sustainability of rice production.

DIRECT SEEDING SAVES LABOUR AND WATER COSTS

The Indo-Gangetic Plain is a large, fertile plain covering most of northern and eastern India, the most crowded regions of Pakistan, and almost all of Bangladesh. The Plain is India's "grain bowl," which produces half of the nation's rice and wheat. Farmers face rising costs, worsening soil health, waning productivity, and labor shortages, as many people migrate to cities to find work. Farmers here depend on monsoon rains, and they cannot establish the crop if the rains come too late.

The partnership program is now tackling these problems by promoting an alternative way to establish a rice crop. Instead of the common method of transplanting rice from a nursery into the field, and flooding the field, rice seeds are sown directly into a non flooded, but puddled field. This approach, known as direct seeding, provides more flexibility for farmers to respond to the monsoon rains. Direct seeding in dry fields allows quicker land preparation and reduces the amount of water and labor needed. It avoids reliance on nurseries and the use of old seedlings if the rains are delayed. However, timely and appropriate weed management is essential to avoid drastically low yields.

Direct-seeded rice matures 10–15 days earlier than a transplanted crop, allowing farmers to sow wheat and other crops earlier. This is extremely helpful for Indian farmers, who plant wheat after harvesting their rice crops. A delay in planting rice causes a delay in planting wheat, and this translates to loss in yield and income.

A farmer in the Philippines uses a drum seeder to directly sow pre-germinated seeds in wet, non-flooded soil

Direct seeding became a savior to farmers in Bengal, India in 2007, when their crops were lost in severe floods. Farmers were able to plant new direct-seeded crops using 2,000 drum seeders (see text box hereafter) that were distributed by NGOs.

BEATING THE DRUM

A drum seeder is a simple, cylindrical tool made of high-density plastic that makes direct seeding easier. As the drum is pulled by one person across a puddled field, pre-germinated seeds placed inside the drum fall neatly in rows. Originally designed by IRRI, improvements by researchers and manufacturers in Vietnam have made it lighter, cheaper, and easier to use. The drum seeder has gained success as a way to save seeds, but its capacity to save labor is overwhelming. While it may take 50 person-days to transplant 1 hectare of rice, it only takes about 2 person-days to directly seed in puddled soil using a drum seeder. Partners in the Philippines, Myanmar, Bangladesh, and India are promoting drum seeders and integrated weed management. Compared with spreading seeds by hand, a drum seeder needs 50–60% less rice seed, the labor cost is saved, and sowing the crop in rows makes manual weed control easier. In areas where farmers use direct seeding and integrated weed management, yields increased by 6% in the wet season and 16% in the dry season.

HELPING FEED THE HUNGRY IN NORTHERN BANGLADESH

With early-maturing varieties and proper weed management, direct seeding has helped ease the hardship of farmers in northern Bangladesh. Each year farmers face the monga or "hunger" months that last from late September to mid-November, when the landless ultra-poor and other rural families are waiting for the harvest of transplanted rice and do not have other means of income. With direct seeding, farmers can harvest their crop at least 35–40 days earlier, sell at a higher price, and grow other crops such as potato, maize, chickpea, or vegetables. This generates important labor opportunities.

An NGO partner introduced these technologies in 2006 to 10,000 farmers in 29 sub-districts. This created jobs for 27,377 laborers who had work at a time when farm work was previously rare.

The Bangladesh Department of Agricultural Extension is now planning to use direct seeding to change the cropping pattern in the wet season, enabling farmers to harvest early, create jobs, and allow crop diversity (by growing mustard, potato, and maize for example). Some 40,000 hectares are targeted for the 2008 wet season.

SITE SPECIFIC NUTRIENT MANAGEMENT: HEALTHY CROPS WITH THE RIGHT AMOUNT OF FERTILIZER

Most nutrients needed by a rice plant for its growth come from the soil, but this supply is not enough to produce high yields to feed billions of people. Nutrients in the form of fertilizer must be applied to supply the additional need of the rice plant. Farmers mostly lack knowledge on the most effective use of fertilizer for their fields, and their inefficient use of fertilizer leads to diseases of the rice plant, damage to the environment, and low profit from farming. Research on nutrient management for rice has led to the development and dissemination of simple technologies to enable poor rice farmers in Asia to increase their production and thereby, their profits, through more efficient use of fertilizer. The approach is called site-specific nutrient management (SSNM), and has been applied across Asia.

Farmer uses the leaf colour chart to find out if their crop has enough or needs more nitrogen fertilizer

A SIMPLE TOOL FOR FARMERS

The leaf color chart is one of the tools developed for farmers to assess the nitrogen needs of their crop. It is a plastic strip with four or more panels that range in color from yellowish green to dark green. Farmers simply compare the color of the leaves with the panels. Dark green leaves mean that the crop has enough nitrogen, while yellowish green leaves is a sign that the crop needs nitrogen fertilizer quickly. As of June 2008, more than 519,000 of these useful tools have been distributed in Bangladesh, China, Indonesia, India, Vietnam, Thailand, Myanmar, Malaysia, and the Philippines.

Since 2003, correct fertilizer timing and application rates have greatly raised farmers' yields compared with their traditional practices. In China, India, Indonesia, the Philippines, and Vietnam, yield increases from adopting SSNM improved net returns by $100 to $300 per hectare per year. Farmers who adopted the technology also reduced their pesticide use.

In 2008, the principles of site-specific nutrient management were compiled into a simple, computer-based nutrient decision system for Indonesia, the Philippines, China, and West Bengal in India. This interactive tool provides 10 multiple-choice questions, which can be answered easily by an extension worker or farmer for a specific rice field or area. In 2008, SSNM principles were disseminated in Indonesia through 60,000 farmer field schools, and is one of the major pillars of a new national program for increasing rice production in the Philippines.

The research has led to important policy changes at national levels in China and Indonesia affecting millions of farmers. In Guangdong, China's major rice-growing province, with 94 million people, innovative nutrient management was endorsed for adoption in 2007.

CLEAN AND GREEN

Applying the right amount of nitrogen fertilizer avoids excessive early vegetative growth. This produces healthy crops that are less prone to disease and insect pest attacks. Farmers can thus apply less pesticide, increase their profits, and lower the risks to their health and the environment.

Increasing the crop's use of the applied nutrients also reduces the risk of nitrogen leaking from rice paddies, polluting water bodies and the air, and contributing to global warming. Scientists used data from farmers' fields and a simulation model to show that improved use of nitrogen fertilizer on crops can reduce the release of nitrous oxide, a greenhouse gas that contributes to global warming and is more than 300 times as potent as carbon dioxide.

REDUCED POST HARVEST LOSSES, BETTER RICE QUALITY AND HIGHER PRICES

Rice farmers in Asia experience post harvest losses because of spoilage and wastage of rice at the farm level, delay in drying, poor storage, poorly maintained or outdated rice mills, and losses to pests throughout the post harvest chain. These losses lead to lower quality rice for consumption, smaller returns to farmers, higher prices for consumers, and greater pressure on the environment as farmers try to compensate by growing more rice or using chemicals to control pests. From harvest to market, farmers are losing 30–50% of their earnings. Two of the biggest problems now being addressed by the partnership program are delayed or improper drying and poor storage.

The main reason for the deterioration of seeds is delayed, incomplete, or ineffective drying. Drying is the most critical operation after harvesting a rice crop. Traditionally, millions of Asian farmers dry their grain by spreading them under the sun on roads, town squares, and other open spaces. To maintain the high quality of grains, mechanical dryers have been developed that are affordable for farmer groups.

Mechanical drying or heated air drying can be done at any time of the day or night, and moisture levels are easily monitored. Use of mechanical drying also reduces labor. In general, mechanical dryers produce better quality rice compared to sun-drying because the rice is uniformly dried. Mechanical drying also leads to a higher milling yield of rice.

A flat-bed dryer with a 4-ton capacity (Myanmar)

The most frequently used dryer for small quantities of rice is the simple flat-bed dryer (pictured above). Construction of flat-bed dryers and training of farmer groups has led to more than 5000 farmers having better quality rice in Myanmar and Laos, which in turn means they can sell their rice to millers at higher prices.

In Indonesia, collaborative research led to the design of more efficient fans for grain dryers. In 2007, this led to milling quality 12–40% higher than that of sun-dried rice.

ENVIRONMENTALLY AND ECOLOGICALLY FRIENDLY

Conventional mechanical dryers need around 10–15 liters of kerosene to dry 1 tonne of paddy rice. However, kerosene is harmful to the environment and is becoming more expensive. These reasons prompted the partnership program with its Vietnamese and Philippine partners to develop dryers that use rice husks as fuel instead of kerosene. Rice husks (a by-product of rice milling) are available in abundance, are low in cost, and their use is more environmentally friendly.

One 4-ton seed dryer with a rice husk furnace was installed in the Philippines, and three commercial furnaces were installed in Vietnam in 2006. These furnaces produced virtually no smoke, less ash, and little carbon dioxide, all of which hurt the environment. Based on the great interest of farmer groups, dryers are now being introduced in Cambodia, Myanmar, Laos, and Indonesia.

An efficient **storage system** is crucial to protect seeds for the next planting season. In humid, tropical conditions, seed and grain quality quickly deteriorate within 3–4 months of storage because rice grains absorb water from the surrounding air, and storage pests, mostly insects, accumulate. Simple airtight containers or storage systems have been developed that enclose and protect the grain from pests and prevent water absorption from the humid surrounding air. The **'Super Bag'** was developed specifically for farmers with small amounts of land. It can store up to 50 kilograms and costs less than $1.50. Post harvest technologies are designed to be as inexpensive as possible to maximize poor farmers' access.

When properly sealed, oxygen levels inside the bag decrease from 21% to 5% and carbon dioxide levels increase. This reduces the number of insects to a ratio of less than one insect for every kilogram of grain without using insecticides—often within 10 days of sealing.

The Super Bag and larger airtight storage systems (with 5- to 200-ton capacity) have been extensively tested and verified with farmers and seed processors in Vietnam, Cambodia, Lao PDR, Indonesia, and Myanmar. Results confirmed that these storage systems control insect grain pests without using insecticides, protect the grain from rodents, maintain a high seed germination rate, and result in less broken grains during milling.

More than 4,000 farmers in Cambodia and Vietnam are now using Super Bags to **store their seeds safely for 6–9 months**. The farmers have been able to **maintain germination rates above 90%**. And, they can now sell more grain in the market since higher germination rates mean they need less grain for seed.

A Lao PDR farmer shows seeds in a Super Bag inside the granary where he also stores his grains fror consumption.

ECOLOGICAL MANAGEMENT OF RODENT PESTS

Across Asia, rats and other rodents can cause preharvest losses ranging from 5% in Malaysia to 17% in Indonesia. To put this into perspective, an average loss of 6% in Asia amounts to enough rice to feed 225 million people—roughly the population of Indonesia—for 12 months. Rat damage is often patchy and family rice plots are small, so it is not unusual for farmers or villagers to lose half of their entire rice crop to rats. Rats and mice cause about 5% of post harvest losses.

By understanding the population ecology and behavior of rat species, farmers can apply a simple **environmentally friendly community method** to control rats in lowland irrigated rice. Trials over 5 seasons in Indonesia and Vietnam, involving 400 farmers, led to a **50%** reduction in the use of chemical rodenticides and increased yields by about 0.5 ton per hectare.

This ecologically based approach to rodent management was adopted as the **national policy for rodent management in Vietnam in 1999, Myanmar in 2006, and Indonesia in 2001**. Farmers in five provinces in Vietnam and four provinces in Indonesia are now routinely using this approach, which has replaced widespread use of rodenticides, cocktails of illegal chemicals, and the use of electrocution—all serious risks to human health.

Rat meat is also an important source of protein for rural people in Vietnam, Lao PDR, and Myanmar. Therefore, reducing rodenticide use offers major health benefits.

Ecologically based rodent management requires timed community action such as rat hunting (photo above, Vietnam) and using community trap-barrier systems. Inspection of a trap-barrier system for catching rats in Indonesia (photo below).

BULIDING THE CAPACITY OF PARTNERS IN DEVELOPING COUNTRIES

The partnership program **builds the capacity of partner countries** by enhancing the skills of researchers, extension workers, and farmers. During the past 3.5 years, more than 100 workshops (12 of them at a national level) covering all technologies were conducted. 75 partners from 10 developing countries were sponsored to attend international workshops or training courses.

The partnership program has been a focal point for critically needed **cross-country learning** resulting in countries sharing different ways to produce irrigated rice and to efficiently get the message to extension specialists and farmers. Most importantly, these findings have also been communicated to policy makers. This has led to **crucial changes in national agricultural policy**—a prerequisite for sustainable changes in rice production in Asia.

Field days in Bangladesh for the promotion of direct seeding, early-maturing varieties, and weed management to help mitigate monga.

Training on the use of the 'Nutrient Manager' to quickly formulate guidelines for specific rice-growing areas. (Indonesia)

WHAT THE FUTURE HOLDS

With the partnership program playing a strong role in many countries across Asia, it has proven to be an excellent platform for delivering new technologies to small-scale rice farmers, especially during the current rice price crisis. The IRRC provides multi-country learning for national scientists and extension specialists in 11 Asian countries, and these partnerships have made a significant contribution to the food security of Asians while maintaining a safe environment.

The partnership program is entering a new Phase in 2009-2012. The focus will be on improving the livelihoods of poor smallholder farmers in Southeast Asia by increasing their sustainable production of rice through the application of technologies from research on natural resource management. A twin approach will be adopted. The first is to foster innovative research, the second is to promote effective pathways for the rapid transfer of mature research technologies to hundreds of thousands of farmers. The partnership program will also continue to provide a strong platform for capacity building and joint cross-country learning. With the continued support of the Swiss Agency for Development and Cooperation, the partnership program will provide an important regional consortium to help address the "Rice Crisis" in Asia.

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Further reading:
www.irri.org/irrc
www.knowledgebank.irri.org
http://solutions.irri.org

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