A Tougher Breed: Rice Cultivation and Research in Southeast Asia

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In tropical and subtropical Southeast Asia, rice plays an enormously important role not only by assuring food security and the people’s livelihood, but also by helping form the social and cultural fabric of the region.

Accounting for more than one fourth of the agricultural production, rice is Southeast Asia’s staple food and principal agricultural crop. It comprises about half of the total per capita caloric intake among the region’s ten countries, reaching levels as high as 80% in some areas. Since rice plays such a significant role in the lives of farmers and consumers, it is not surprising that the grain occupies a major position in the cultures of Southeast Asia.

In fact, rice was and is an integral part of Southeast Asian cultures, and it is often mentioned in the scriptures of the region’s ancient civilizations. Rice cultivation was considered the basis of the social order and heavily influenced regional customs and religions.

Because rising rice prices often led to civil unrest, maintaining self-sufficiency in rice production and keeping rice prices stable and affordable for the poor is a top political priority for almost all the region’s national governments. All things considered, rice is regarded as an important strategic commodity in Southeast Asian countries.

Since the mid-1960s, rice production has kept pace with population growth and changing trends in food consumption. Most of the heightened production was made possible by the development of modern, short-stemmed rice cultivars which increased rice plant yield. The short-stemmed plant, which was developed by the International Rice Research Institute (IRRI) and its partner research institutions in Asia, responds more efficiently to increased fertilizer inputs than the taller, traditional rice varieties. This post-Green Revolution increase in production also resulted in a reduction in the real price of rice which allowed poor people in Southeast Asia to buy more food.

Despite these advances in rice production, food insecurity and poverty are still widespread. According to the World Bank, more than one billion people still live in poverty, and 840 million suffer from hunger world-wide, 70% of them in Asia. With the exception of Thailand, populations continue to grow rapidly in Southeast Asia at rates of 1.5-2.8% per year.

The catastrophic implications of high population growth are best illustrated by the estimated future demand for rice. Twenty-five years from now, the rice farmers of the world will have to increase production by 50% just to maintain current consumption levels. In the Philippines, demand for rice will increase by 65%; Malaysia, 56%; Vietnam, 45%; Myanmar, 42%; and Indonesia, 38%.
Another threatening fact to consider is that these bewildering production increases will have to be achieved under several substantial constraints: a decrease in arable land due to urban encroachment and industrialization, a threatened water supply due to increased usage in cities and industry, a trickling labor supply due to the migration of landless peasants to the cities in search of jobs, and fewer chemical inputs to protect the agricultural environment from further degradation through the over-use of pesticides.

The Role of Rice Research
The land, water, and chemical input constraints mentioned are here to stay. Thus, research is the only way to cope with increased rice demand. Current research aims to develop: rice plants that have increased yields and built-in resistance to diseases; plants that can withstand drought as well as the flooding that occurs in the river deltas of the region; rice with increased nutritive qualities; and rice-growing practices that will increase the income of small farmers, slowing the migration from rural to urban areas.

The IRRI plays a leading role in rice research. A non-governmental organization based in Los Baños, Philippines, the IRRI was founded in 1960 with initial support from the Ford and Rockefeller foundations. Its goal is to improve the well-being of present and future generations of rice farmers and consumers, particularly those with low incomes. Working with national agricultural research systems in developing countries and with advanced research institutions in industrialized nations, the IRRI has successfully addressed the leading constraints of increasing rice production.

The major research tool in the struggle to increase rice production—as it was 30 years ago—is the design of new rice plants. In the mid-1960s, the IRRI developed a line of short-stemmed, high-yielding plants that increased yields by a factor of two to three to counter the famine projected in the 1970s for many Asian countries. These plants also provided improved food security that has lasted until the present day. Now, a new plant has been engineered to meet the changing needs of the 21st century.

Breeding work on this new plant type began in 1989. Since then, more than 2,500 crosses from different plants have been made, 150,000 pedigree plant nursery rows grown, and numerous breeding and more vigorous root system anchors the plant and prevents it from falling over. The new plant also has thicker and darker leaves that allow for more effective photosynthesis.

Yields of these new plant varieties are 20% higher than any previous strains. New plant types have been genetically engineered to be more disease and pest resistant. Some strains have resistance to destructive diseases such as blast and bacterial blight, as well as to insects such as the green leafhopper and brown planthopper. Breeding for resistance to the tungro virus and stem borers is currently under way. Breeding is also under way to change the short and round shape of the grains, since consumers in the tropical and subtropical prefer long and slender grains. These new, improved varieties with multiple resistance, higher grain quality, and 20% higher yields will become available to farmers in four to five years.

Micronutrient deficiency, commonly called "hidden hunger," affects more than two billion people worldwide. In the Philippines, nearly one-third of the population has anemia, caused by dietary iron deficiency. Pregnant women and young children are heavily affected because of their greater physiological need for iron. Iron deficiency also lowers work

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Pesticide propaganda

performance, and has been linked to weakened immune systems. Deficiency caused by cereal-based diets can be improved with the addition of meats and green vegetables, but in many developing countries, such products are not easily available.

In response, the IRRI initiated a project in 1994 to develop high-iron rice. Last year, the Institute developed two new varieties that combined a high iron concentration with high crop yields. These varieties are expected to have an impact on human nutrition and health in the region.

Pest Management

In the early days of modern rice farming in the 1960s, farmers were encouraged to minimize risk through the use of insecticides. Recent ecological studies, however, have shown that applying insecticides too early in the growth cycle does more damage by killing friendly insects which prey on pests that come along later in the season.

Accordingly, the IRRI’s scientists began to develop resistant rice varieties that do not require insecticides. Such research is based upon integrated pest-management (IPM) practices, which have become increasingly popular in the ricefields of Southeast Asia. The basic premise of IPM is that no single pest control method can be successful over a long period of time. What is needed is a mixture of control methods—biological, physical, and chemical—that can be integrated into a cohesive strategy that provides sustainable and inexpensive pest management.

Unfortunately, due to pressure from local retailers of pesticides, it is difficult to convince even one farmer to spray less often. A major question remains: how do researchers change the behavior of the world’s 300 million rice farmers?

In the search for an answer, researchers from Vietnam and the IRRI launched a media communication project in the Long An province of Vietnam’s Mekong River Delta. The project involved a campaign to spread the IPM “rule of thumb” message that it is not necessary to spray insecticide to control the leaf folder insect in the first 40 days after sowing. The media campaign included posters, leaflets, radio commercials, magazines, newspapers, billboards, demonstration plots, and word-of-mouth communication. The coverage was extensive, reaching 97% of farmers in the study areas, and 82% of farmers in the targeted province. Leaflets, radio drama, and posters, in that order, had the greatest effect.

Thirty-one months after the launch of this media campaign, dramatic changes resulted. The proportion of farmers spraying at the three early stages of plant growth had been reduced from 59%, 84%, and 85% to 0.2%, 19%, and 30%, respectively, while those who did not use any insecticide rose dramatically from 1% to 32%. The proportion of farmers who believed that leaf folders would cause losses in rice production fell from 70% to 25%, and those who believed that early season spraying was necessary fell from 77% to 23%.

The program was then adopted by agricultural extension services in the Delta’s other 15 provinces, which contain 2 million farmer households. Finally, in November 1998, the Vietnamese government advised pesticide companies that it would no longer consider leaf folder control a justification for pesticide registration.

Withstanding Ecological Challenges

Normal rice plants cannot withstand prolonged submersion in water. They usually die after several days of water coverage. Centuries of selection by farmers in the 20 million hectares of flood-prone rice fields of South and Southeast Asia, however, have produced many traditional varieties of rice that can adjust to flooding, and some whose growth is triggered by rising water. Deepwater rice tolerates water depths of 50-100 centimeters, and floating rice can survive water depths of up to four meters. Another variety, tidal wetland rice, can survive temporary submersion, sometimes even in salty water.

Unfortunately, all of these traditional rices have low yields, often less than one ton per hectare, because much of the plants’ nutrient intake goes into the production of the long stems essential to keeping their heads above water.

In a breeding program spearheaded by two Thai research stations and the IRRI, fifteen new rice varieties have been introduced to farmers in Cambodia, Myanmar, Thailand, and India. These new varieties can triple and perhaps even quadruple current yields to as high as 3.4 tons per hectare. The significance of this breakthrough is that the flood-prone regions of Asia are home to millions of the
world’s poorest people, so increasing the annual rice harvest in these ecologically fragile areas will greatly improve the quality of life.

The IRRI in Laos and Cambodia

Slash-and-burn agriculture, the most commonly practiced rice production technique in the ecologically fragile, wet highlands of northern Laos, is contributing to environmental destruction. This practice causes virtually irreversible soil degradation. Now, however, Laotian and IRRI scientists are collaborating in developing strategies aimed at halting this process by contouring hedge-rows to decrease soil loss through water run-off, rotating rice with soil-improving crops such as legumes and cash crops to increase the incomes of poor farmers, and making fallow lands more productive by using fallow vegetation to raise livestock.

Many years of destruction and suffering—the Vietnam War and the Cambodian Civil War as well as the cruel dictatorship and mass killings of Pol Pot’s Khmer Rouge regime—left the one-time rice-exporting nation of Cambodia unable to produce enough rice to feed its own people.

The agricultural research and extension structure had been totally destroyed, and research facilities and their seed banks no longer existed. Much of the irrigated farmland was unusable because of deteriorated irrigation systems and the large-scale laying of anti-personnel mines in and around the ricefields. Most of the researchers had either disappeared in the killing fields or fled the country. Many of Cambodia’s traditional rice varieties had been lost; the country’s rice-growing area had contracted to 20% of its former size, and the seed stocks were being consumed by starving refugees.

In 1987, the Cambodian government invited the IRRI to help it restore its rice production capability to what it had been before the troubled 1970s. With financial support from Australia, the IRRI launched the Cambodia-IRRI-Australia Project to help the country establish and implement national research and development programs in rice production systems.

This project met with tremendous success. Researchers and engineers have been trained, the agricultural infrastructure rebuilt, and Cambodia’s lost seed stock restored. In 1996, the World Food Program and the Food and Agricultural Organization of the United Nation showed that Cambodia had not only achieved self-sufficiency in rice production for the first time in 25 years, but it had also produced a small surplus for export.

As IRRI heads toward the year 2000, it can look back on four decades of real success in rice research for the benefit of rice farmers and consumers in Southeast Asia and elsewhere in the world. And this is success that can be easily measured. Since the mid-1980s, world market prices for rice, adjusted for inflation, have been maintained at just 40% of what they were in the 1950s and 1960s, and less than one-third what they were during the world food crisis of the mid-1970s.

This represents a major increase in purchasing power for poor consumers, while the rising yields produced by research have allowed the incomes of rice farmers to increase despite the fall in unit price for their product. In addition, the increased intensity of cropping made possible by the new rices has increased the demand for labor and allowed farm wages for landless rural workers to rise. Thus research has been the key to resolving the dilemma of improving the purchasing power of small landowners, landless workers, and consumers, all at the same time.

For the moment, the global rice system seems to be resilient. World rice prices (in dollars) did not increase substantially despite the ravages of the recent drought in Indonesia and the Philippines, and the floods in Bangladesh. In local currency terms, however, world rice prices have increased due to the sharp depreciation of many of the region’s currencies in the wake of the Asian financial crisis. If these higher prices on world markets are transmitted to domestic markets, they will reduce the buying power of poor urban consumers, as well as of those rural poor who do not produce their own rice.

In addition, because of continuing population growth, and rising incomes in the cities, the demand for rice keeps growing, and the achievements of the past will not provide for the needs of the future without continuing rice research aimed at yield and production increases. And unless continued funding for such rice research can be guaranteed, the risk of greater food insecurity for the millions of poor in Asia remains a very real threat.