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The king of rice
Political support for rice research
Environment special
The importance of biodiversity
Environmental solutions in Java

Once were rice fields
Typhoons devastate Asian rice-farming communities

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PHILRICE

The Philippine Rice Research Institute is the country's leader in rice research and development (R&D). It is a corporate entity supported by the Philippine government and attached to the Department of Agriculture.

PhilRice focuses its R&D efforts by addressing the key production constraints in favorable and unfavorable rice environments in the Philippines. The institute develops and promotes technologies that are ecosystem-based, location- and problem-specific, and profitable for all Filipino farmers. These include high-yielding and cost-reducing production practices.

PhilRice has seven strategically located R&D centers and collaborates with a network of government, private, and non-government organizations.

In pursuit of its mission, PhilRice is guided by an integrated management system (ISO 9001:2000 [Quality Management System], ISO 14001:2004 [Environmental Management System], and OHSAS 18001:1999 [Occupational Health and Safety Assessment Series]). Its IMS proves that the Institute is very faithful in its quest for sustainable rice farming, quality management, and a healthy and safe environment.

We are PhilRice– serving the Filipino farmers, caring for the environment.

PHILRICE

Serving the farmers, caring for the environment

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On the cover:
John Oliver Leron crouches in front of what were rice fields in Bicol, Philippines, before Typhoon Durian obliterated them in November 2006 (see pages 20-25).

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Is the rice ball rolling?

In many ways, rice is one of Asia's biggest contradictions. It is fundamental to the region's economic development and the foundation of many of its most important cultures and yet—apart from being consumed each and every day—it is often ignored as a major issue and many young Asians treat it with general indifference.

But, over the past few years, there have been signs that this is changing. Not only are Asia's politicians paying more attention to rice, but so too are some of the region's young people. It's not exactly a rice revolution; there is enough attention now being paid to rice in Asia to suggest that some important new developments may be on the way.

What difference does it make if rice gets strong political and public support? The last time rice got attention like that was way back in the late 1960s and '70s when it helped launch the Green Revolution that played a major role in Asia's subsequent economic growth and development. You literally had presidents—such as Lyndon B. Johnson of the United States—and prime ministers visiting the rice paddies of Asia to learn more about new agricultural technologies and how they could improve people's lives. Such strong political support and attention helped guarantee the development of the region's rice production, which in turn helped power Asia into one of greatest periods of economic growth and poverty alleviation the world has seen.

Since the United Nations declared 2004 as the International Year of Rice, there have been small but significant signs of a resurgent interest in rice in Asia. At the 1st International Rice Congress in China in 2004, most of the rice-producing nations of Asia signed the Beijing Declaration on Rice confirming the grain's fundamental role in their cultures and economies. In the same year, the agricultural ministers of the ten nations of the Association of Southeast Asian Nations (ASEAN) started working with the International Rice Research Institute (IRRI) on a rice research agenda that this year in Singapore was finally endorsed with a special focus on the environment and capacity building.

Also, at the 2nd International Rice Congress in Delhi last year, many of the rice-producing countries of Asia went one step beyond their declaration in Beijing 4 years earlier by endorsing the Delhi Declaration, which called for a strengthening of the existing rice research partnership across the region. Such renewed interest in and commitment to rice in Asia are coming just in time (for a wrap-up on the ASEAN and Delhi developments, see *Agricultural ministers come together over rice* on pages 18-19).

Rice production across the region faces a truly formidable set of challenges, starting with the urgent need to produce more rice with less land, labor, and water. The good news is that we now have the scientific knowledge and strong national research networks needed to overcome such problems in ways that are not only sustainable but also more profitable for farmers.

Clearly, Asia stands on the threshold of a revolution in the way it grows and consumes its rice—all that's needed now is the public and political will to make sure all involved, from farmers to consumers, benefit in the best possible way.

Duncan Macintosh
Publisher

IRRI changes copyright policy

After being given an important new role by the rice-producing nations of Asia to support the free flow of rice research and knowledge, the International Rice Research Institute (IRRI) is making an important change to its copyright policy from the original "all rights reserved."

The change effectively echoes the software industry's open-source movement. Others will now be able to use IRRI's intellectual property without restriction provided they do not place restrictions on its use by anyone else.

The practical change will not be great—IRRI previously offered relatively free use of its information to other parties. The major difference now is that users no longer need to ask permission. The change is also symbolic, representing the Institute's goal of promoting the free exchange of ideas and information.

IRRI's decision follows the release of the Delhi Declaration on Rice by the Ministerial Round Table at the International Rice Congress in New Delhi, India, on 9-13 October, wherein the Institute was asked to "host a task force ... to prepare a road map" that would help achieve the main objectives of the declaration, which include a plan "to establish a comprehensive partnership among the participants through strengthened dialogue on a regular basis for strengthening rice research and development efforts."

RDA

THE NEWLY developed Bokto seeder—rapidly adopted by South Korean rice farmers over the past 2 years—has been successfully tested on a North Korean farm. The seeder (*pictured*) allows farmers to plant rice with precise sowing depth and even seedling establishment. It also offers simultaneous silicate application and placement of basal fertilizer, resulting in high nitrogen-use efficiency. These features help farmers improve seedling stand, avoid lodging, and improve yields and grain quality. The seeder was developed by Kwang-Ho Park from the Korea National Agricultural College of the Rural Development Administration. Professor Park has also worked on transferring the technology to farms in South Korea and, now, North Korea.

Three into four will go

The December 9 issue of *The Economist* reported on IRRI leading an effort to transfer the more efficient photosynthetic process of maize (called C_4) to rice, which has a less efficient C_3 process. IRRI crop scientist John Sheehy plans to screen the Institute's collection of 6,000 wild rice varieties to see if any display a predisposition for C_4 photosynthesis, which, if successfully transferred to commercial rice varieties, would enable higher yields under tougher conditions. IRRI Director General Robert Zeigler admits the task is daunting and will take 10 years or more. But the potential is enormous.

Iron-fortified rice

The Swiss Federal Institute of Technology (ETH) in Zurich has, for the first time, been able to fortify rice with iron. In clinical trials, the rice—which has had iron added, as opposed to rice with endogenous high iron content—helped overcome iron deficiency in Indian schoolchildren.

A team led by scientist Michael Zimmermann conducted a study on 134 primary school children between the ages of five and nine in Bangalore, India. For 16 weeks, a proportion of the children—who all suffered from iron deficiency, and some also from anemia caused by the deficiency—were given the iron-enriched rice as part of their lunch. A control group received the same meal with ordinary rice.

After the trial, the proportion of children in the fortified rice group suffering from iron deficiency fell from 78% to 29%. Additionally, the proportion of those with an excessively-high lead level dropped from 65% to 29%. The number of children in the control group similarly afflicted decreased only slightly, due to the meal that was offered daily.

Dr. Zimmermann said, "This is a breakthrough because it is the first time that rice has been successfully fortified with iron. Since there is no patent on the technique, it can be used anywhere."

Securing access to biodiversity

ARIEL JAVELLANA

World agricultural research leaders have signed agreements that guarantee long-term access to the world's most important collections of agricultural biodiversity while requiring commercial users to share benefits with the global community.

In a 16 October 2006 ceremony that took place on World Food Day, 11 centers of the Consultative Group on International Agricultural Research (CGIAR), including IRRI, placed their genebank collections under the International Treaty on Plant Genetic Resources for Food and Agriculture, now ratified by 105 countries.

CGIAR centers hold more than 600,000 samples of crop-plant diversity. This includes wild relatives and more than half of the world total of farmer-created varieties, which are a rich source of sought-after breeding traits. IRRI itself holds more than 100,000 rice germplasm samples in its T.T. Chang Genetic Resources Center.


AL BENAVENTE

RENOWNED Japanese sculptor Mitsuaki Tanabe—creator and donor of the Momi wild rice seedling sculpture in IRRI's Riceworld Museum and Learning Center—plans to hold an exhibition entitled "MOMI-TAIWAN 2007: In Situ Conservation of Wild Rice," at the National Taiwan Museum of Fine Arts in March and April 2007. Momi is the Japanese word for unhulled rice. The exhibition will promote the need to revive Taiwan's traditional wild rice growing areas, which have been lost since the 1970s. Tanabe has long championed the conservation of wild rice, many species of which harbor traits that can be bred into cultivated varieties.

Boost for rice reserve

Japan, South Korea, and China may join the emergency rice reserve program of the ten-nation Association of Southeast Asian Nations (ASEAN), according to a 22 November Bloomberg report.

The newcomers would boost by more than five times—from 87,000 tons in 2006 to as much as 500,000 tons in 2007—the stocks available to the group's members should they be affected by calamities.

Although, according to the United Nations, global rice production may have increased to 634 million tons in 2006, the U.S. Department of Agriculture has said that inventories of the world's most important crop are near a 26-year low and will drop further.

The reserve, established in 1979, is made up of rice stocks held in each of the member countries that are earmarked for emergency distribution by ASEAN countries that require food after natural or human-created disasters.

ASEAN comprises Indonesia, Malaysia, Singapore, Thailand, Myanmar, Lao PDR, Cambodia, Vietnam, Brunei, and the Philippines.

JOSE RAYMOND PANALIGAN

BRIEFLY

Flood-tolerant rice for Indonesia

IRRI has provided Indonesia with seeds of a recently developed submergence-tolerant version of the popular IR64 variety. The Indonesian Agency for Agricultural Research and Development plans to test the performance of the submergence-tolerant lines in flood-prone areas of the country. For more on submergence-tolerant rice, see *From genes to farmers' fields* on pages 28-31 of *Rice Today* Vol. 5, No. 4.

Genome discrepancies

Discrepancies between the draft rice genome sequence released in 2002 (by the Beijing Genomics Institute and the Syngenta Corporation) and the sequence released in 2005 (by the International Rice Genome Sequencing Project) prompted some scientists to question the validity of the results. The two groups used different techniques to obtain the sequence, with the former employing a "whole-genome shotgun method" and the latter a map-based approach. Jun Yu and colleagues investigated this problem in the August 2006 issue of *Trends in Plant Science*. In their article, *Comparing the whole-genome-shotgun and map-based sequences of the rice genome*, they argue that the most serious differences between the sequences are mostly found in highly variable areas of DNA that are not part of the rice genes themselves. Once this is factored in, say the authors, there is "remarkable agreement in the sequences produced by these two methods."

Record rice yields

Egypt recorded the world's highest national average yield—9.5 tons per hectare—in 2005, thanks in part to a United Nations Food and Agriculture Organization (FAO)-led project to develop and use hybrid rice varieties. Some of the locally developed hybrid varieties outperformed the best Egyptian varieties by 20–30%, according to the FAO. The project, aimed at growing more rice with less water and less land, also involved training seed breeders, production personnel, extension workers, and farmers. Despite the success, the FAO notes that hybrid rice seed production is not appropriate for some areas, as many countries lack the technical capabilities and infrastructure to carry out such programs.

Vietnam trade restricted

Vietnamese Prime Minister Nguyen Tan Dung last November instructed traders to stop exporting rice without government approval, according to a November 2006 Associated Press report. In a statement, the prime minister said that natural disasters such as typhoons and pest infestations had reduced food production, increased prices, and threatened food security. According to the report, traders would be able to export rice as part of government-sponsored export contracts with Cuba and Indonesia. Any other contracts would need government approval.

Rice fashion

Scientists at the University of Nebraska–Lincoln plan to turn rice straw into conventional-looking fabric as a way to reduce the use of petroleum-based synthetic fabrics. The researchers are developing cotton-like fabric from the

Africa Rice Center wins United Nations award

The Africa Rice Center has been named as winner of the 2006 United Nations Award for South-South Triangular Partnership in recognition of its New Rice for Africa (NERICA) initiative.

This award is presented to individuals or institutions for "spearheading, transforming, empowering, mobilizing, and/or expanding the South-South agenda by increasing human and financial resources of the South through partnership for development."

"WARDA is receiving this award because of its pioneering efforts in brokering North-South partnerships in order to create hybridized varieties of rice applicable to conditions in the South," said His Excellency Eladio Loizaga, permanent representative of Paraguay to the United Nations and president, High-level Committee of South-South Cooperation of the United Nations General Assembly.

The groundbreaking NERICA work earned research leader Monty Jones—then an Africa Rice Center scientist—the 2004 World Food Prize, the first-ever won by an African. Dr. Jones is currently the executive secretary of the Forum for Agricultural Research in Africa.

The formal award ceremony was scheduled to take place on 19 December 2006 at United Nations headquarters in New York City, USA, to mark the third United Nations Day for South-South Cooperation. His Excellency Kenzo Oshima, permanent representative of Japan to the United Nations, has been invited to present the award and invited speakers include United Nations Secretary-General Kofi Annan and former U.S. President Bill Clinton.

For more on NERICA, see *In search of new seeds* on pages 30-31.

IRRI DIRECTOR General Robert Zeigler (*right*) briefs World Bank President Paul Wolfowitz on IRRI's new Strategic Plan *Bringing Hope, Improving Lives* at the annual general meeting of the Consultative Group on International Agricultural Research (CGIAR) in Washington, D.C., on 5 December 2006. At the same meeting, Dr. Zeigler gave a presentation that outlined the plans of CGIAR-supported centers, including IRRI, to engage the climate-change research community in an increasingly urgent effort to develop climate-adapted agricultural technologies—such as drought-tolerant crops—and help mitigate global environmental change.

straw, as well as wool-like fabric from chicken feathers. Rice-straw fibers have already been developed using a chemical process that is now under patent review. The researchers anticipate that rice fibers will be able to be spun into fabrics using common textile machinery.

Espresso pesticide

Researchers at the U.S. Department of Agriculture's National Wildlife Research Center in Fort Collins, Colorado, think they've discovered a simple way to keep blackbirds away from rice fields: coffee. It seems that, unlike humans, birds don't like caffeine. Working with chemists, the team was able to make a caffeine solution that could be sprayed on fields. When applied to rice crops in trials, the caffeine spray reduced the number of seeds lost to pecking by up to 76%.

Mobile rice clinic

A team of PhilRice rice production experts will tour towns in Pangasinan, Nueva Ecija, and Pampanga provinces as part of the mobile rice *tekno klinik* (techno clinic), a consultation activity whereby some 100 farmers per municipality will be given a chance to consult with rice experts on varieties and seeds, crop protection, and nutrient management.

Rice News 1,000th story

IRRI
Rice News Worldwide

In December 2006, a feature quoting IRRI Director General Robert Zeigler on climate change in the UK newspaper *The Guardian* became the 1,000th story placed on IRRI's Rice News Worldwide since it began on 22 June 2005. See for yourself stories from other major outlets such as the BBC, the *International Herald Tribune*, India's *Financial Express,* Reuters, and many others at http://ricenews.irri.org.

Pollution stunts rice harvest

A paper published in the 26 December 2006 issue of the *Proceedings of the National Academy of Sciences* suggests that the combination of global warming caused by greenhouse gas emissions and the smog seen over much of Asia—known as the "atmospheric brown cloud"—has negatively affected rice harvests in India over the past two decades. According to the researchers, India's rice production would have been more than 14% better from 1985 to 1998 without the negative combined effects of greenhouse gas emissions and the brown cloud. Further, there has been no sign of improvement in more recent years.

Rice commerce

The World Rice Commerce Conference, held 18-19 October in Ho Chi Minh City, Vietnam, attracted more than 200 delegates, representing most of the world's major rice buyers and sellers. Melissa Fitzgerald, head of IRRI's Grain Quality, Nutrition, and Postharvest Center, gave a presentation on *Certification and the international rice trade: developing a way forward*, which focused on new technologies that allow rice traders to better certify the rice they buy and sell.

Nobel for former IRRI board member

Former IRRI Board of Trustees member (1989-94) and economist **Muhammad Yunus** has won the Nobel Peace Prize for 2006.

Dr. Yunus developed microcredit under the belief that credit is a right, not a privilege, and that those who possess the least should be the first, not the last, to receive a loan. This philosophy led him to set up the Grameen Bank in Bangladesh in 1976. Grameen Bank itself shares the prize with Dr. Yunus.

Another key Grameen Bank principle is that loans should be made predominantly to women, who are often best placed to serve the needs of their entire family. As of May 2006, the bank had 6.61 million borrowers—97% of whom are women—and more than 200 branches providing services in more than 70,000 villages across Bangladesh.

Achievements

Colin McClung, former associate director at IRRI (1964-71), shared the 2006 World Food Prize with former Brazilian Agriculture Minister Alysson Paolinelli and former technical director of the Brazilian Agricultural Research Corporation's Cerrado Research Center Edson Lobato. The recipients played a vital role in transforming the Cerrado—a formerly infertile region of tropical high plains stretching across Brazil—into highly productive cropland.

The United States House of Representatives voted on 6 December to honor World Food Prize Founder and 1970 Nobel Peace Prize Laureate **Norman Borlaug** with the Congressional Gold Medal of Honor, the nation's highest civilian honor. Dr. Borlaug led the development of modern, high-yielding wheat varieties through his work with the Rockefeller Foundation and the International Maize and Wheat Improvement Center. His approach was subsequently adopted with similar results in rice. Dr. Borlaug is widely credited with ushering in the Green Revolution of the 1960s, thus averting widespread famine.

ROLAND BURESH receives his medal from IRRI senior scientist T.P. Tuong.

MARD

The Vietnam Ministry of Agriculture and Rural Development presented a medal of merit to IRRI soil scientist **Roland Buresh** in August 2006. IRRI anthropologist **Florencia Palis** received a best paper award for *The social and cultural dimensions of rodent pest management* during the International Conference on Rodent Biology and Management in Hanoi, Vietnam, 28 August-1 September 2006.

Vito Butardo, Jr., of IRRI's Grain Quality, Nutrition, and Postharvest Center, received a Ph.D. scholarship under the Australian Leadership Awards program.

Rice breeder **B.D. Pathinayaka** of the Sri Lankan Department of Agriculture received the IRRI award for outstanding rice scientist during the Sri Lanka-IRRI Work Plan Meeting at the Plant Genetic Resources Center in Gannoruwa on 30 September 2006.


AILEEN LAPITAN

IRRI GEOGRAPHIC information systems (GIS) researcher Aileen Maunahan performs ground truthing—collecting GIS data on location—with a global positioning system device in an IRRI experimental field. The photo won social scientist Aileen Lapitan third prize in the 2006 IRRI Filipino Scientists Association photo competition in November.

Keeping up with IRRI staff

Reiner Wassmann joins the Crop and Environmental Sciences Division (CESD) as coordinator of the Rice and Climate Change Consortium. Dr. Wassmann previously worked at IRRI on secondment from the Fraunhofer Institute for Atmospheric Environmental Research in 1993-99. **Elizabeth Humphreys**, former principal research scientist at the Commonwealth Scientific and Industrial Research Organisation's Land and Water Division in Australia, also joins CESD as an international research fellow and Challenge Program for Water and Food team leader. **Zainul Abedin** has rejoined IRRI as FoSHol project team leader and IRRI representative in Bangladesh.

Marco van den Berg began in November 2006 as head of Information Technology Services. He replaces **Paul O'Nolan**, who, during 7 years at IRRI, oversaw a period of immense change during which the Institute made important gains in its information technology capabilities.

IRRI also welcomes **Zhao Ming**, IRRI liaison scientist for China; **Hao Chen**, postdoctoral fellow, Plant Breeding, Genetics, and Biotechnology (PBGB); **Daisuke Fujita**, project scientist, PBGB; **Zahirul Islam**, international research fellow, Social Sciences Division; **Minu Joseph**, postdoctoral fellow, PBGB; **Susanna Polleti,** postdoctoral fellow, PBGB; **Edilberto Redoña**, senior scientist, PBGB, and International Network for the Genetic Evaluation of Rice coordinator; and **Dule Zhao**, postdoctoral fellow, PBGB. IRRI bids farewell to **Jingsheng Zheng**, postdoctoral fellow in PBGB (2004–06).

IRRI also says farewell to Board of Trustees member **Fazle Hasan Abed** (2001-06) and welcomes three new board members: plant pathologist **Jillian Lenne** (U.K.), financial management specialist **M. Syeduzzaman** (Bangladesh), and plant biotechnologist **Usha Barwale Zehr** (India). Dr. Zehr, as part of the IRRI-International Maize and Wheat Improvement Center Alliance, will act as the institutes' first shared board member.

TYPHOON XANGSANE flattened rice fields around IRRI's hometown of Los Baños and (*below*) flung debris across the research campus.

GREG FANSLOW

Beating the WEATHER

by Duncan Macintosh

Every year, typhoons and other extreme weather events devastate rice fields—but new research is helping protect rice farmers

JOSE RAYMOND PANALIGAN

Typhoons are one of the oldest and most destructive challenges facing rice production in tropical Asia. These vicious storms flatten crops, shatter grain, and make harvests impossible.

And it's not only the areas hit with the violent winds of a typhoon that suffer. Every year, crops in some of Asia's most important rice regions are flooded by rains that emanate from typhoon weather systems. Seasonal flooding causes an estimated US$1 billion in losses each year.

As *Rice Today* went to press, 22 tropical storm systems had swept across rice-growing Asia in 2006, causing widespread destruction. In September and October, Typhoon, Xangsane (see *Packing a nasty punch* on page 10), destroyed more than 800,000 hectares of rice and caused over half a billion dollars in damage in rural areas alone.

JOSE RAYMOND PANALIGAN

IRRI

GREG FANSLOW

CLAIRE ARBOLEDA, seen here holding her one-month-old son Angelito, lives with her husband in the town of Bay, close to IRRI headquarters. On 28 September, in the same place she stands here, floods from Typhoon Xangsane rose to the level of her shoulders when the raised roadbed of the national highway effectively formed a long dam that flooded upslope areas. Less than 200 meters away, a man drowned in his house.

Packing a nasty punch

In late September and early October 2006, Typhoon Xangsane or its remnants swept across five nations—the Philippines, Vietnam, Cambodia, Laos, and Thailand. A category 4-equivalent storm (wind speeds of 210–249 km per hour and storm surges of 4.0–5.5 meters), Xangsane was the 16th tropical storm and ninth typhoon of the 2006 season.

Xangsane made landfall in the Philippines on 27 September, battering the archipelago's northern islands with torrential rains and strong winds, and causing widespread flooding and landslides. On 28 September, the typhoon passed directly over the International Rice Research Institute (IRRI) just south of Manila and, after emerging over the South China Sea, made a second landfall in central Vietnam, before moving on to cause major flooding and landslides in Thailand. It also caused heavy rains in northern Cambodia and southern Laos. Xangsane was responsible for around 300 deaths, with two-thirds of these in the Philippines.

IRRI itself sustained extensive damage but escaped lightly compared with many residential areas and other organizations. The Philippine National Plant Genetic Resources Laboratory in the Institute of Plant Breeding, University of the Philippines Los Baños, for example, suffered damage to or loss of 70% of its accessions.

The overall regional damage estimates for the storm are

- Rice area damaged or destroyed: 869,000 hectares—Philippines: 125,000 hectares; Thailand: 444,000 hectares; Vietnam: 300,000 hectares.
- Rice price increases recorded across the affected region.
- Damage estimated at more than US$700 million—Vietnam: more than $600 million; Philippines: more than $100 million.
- People affected (mainly rural): 6.8 million—Philippines: 2 million; Thailand: 3.5 million; Vietnam: 1.3 million.

On 30 November, Typhoon Durian slammed into the Bicol region of the Philippines, causing landslides that killed hundreds of people (see *Once were rice fields* on pages 20-25).

Many scientists now expect that climate change may increase the frequency and severity of extreme weather events such as typhoons, and—perhaps just as damaging—alter their timing and location.

In 2004, the final sequencing of the rice genome by a Japan-led international consortium signaled a knowledge revolution in our understanding of the rice plant. This new knowledge accelerated the development of flood-tolerant rice, a technology that could save hundreds of millions of dollars in losses across Asia every year. Although rice thrives in standing water, like all crops it will die if completely submerged for more than a few days. The development and cultivation of the new flood-tolerant rice varieties are expected to increase food security for 70 million of the world's poorest people and provide protection for millions of rice farmers in Asia and Africa (see *From genes to farmers' fields* on pages 28-31 of *Rice Today* Vol. 5, No. 4).

The development of a flood-tolerant rice variety for India shows that modern science can help protect rice farmers from the flooding caused by typhoons. Every year, extreme weather events such as typhoons affect rice production. As the climate continues to change, this is only expected to get worse. Already, IRRI has had urgent requests from Bangladesh, the Philippines, and India for the new flood-tolerant rice.

But there is good news. As our knowledge of the rice plant grows rapidly, rice researchers can help protect rice farmers—and therefore rice consumers—from the disastrous effects of extreme weather such as typhoons.

AS WELL as rudely damaging IRRI's welcome sign, Xangsane destroyed research trials (*top left*) and caused flooding throughout the campus (*top middle and right*).

JOSE RAYMOND PANALIGAN

HIS MAJESTY King Bhumibol Adulyadej harvests rice at Prachin Buri in 1998.

ROYAL HOUSEHOLD BUREAU

The Rice King

by Bob Hill

Thai rice farmers are fortunate to have a head of state who does more than offer symbolic support—His Majesty the King of Thailand is a monarch who genuinely makes a difference

A patron is defined as a distinguished person who gives support to an organization or cause by accepting an honorary position.

Since there is no more distinguished person than a king, it follows that royal patronage is something special. It is recognition from a royal figure that the work of an organization is so deeply favored that it warrants not only a public declaration of support, but also that such support is of a long-standing nature. Moreover, royal patronage is rarely granted outside a monarch's kingdom.

The International Rice Research Institute (IRRI) is both privileged and honored to have as its Royal Patron "the Development King," King Bhumibol Adulyadej of Thailand. For while mental visions of spectacle and

formality inevitably tumble into any consideration of royalty, it is astonishing, with a perception thus blurred, to discover that there is another, largely unpublished, side to the remarkable reign of King Bhumibol: a selfless dedication to the welfare of his subjects that vastly outweighs the notional bounds of noblesse oblige.

For much of his 60 years on the Thai throne, King Bhumibol has ventured restlessly throughout every corner of his kingdom, often spending more than half of any year away from Bangkok, studying the countryside, listening to the problems of his people, proposing, suggesting, innovating, and inventing.

His ideas and suggestions, after considering the people's needs, the physical environment, and agricultural practices, have been put to the test in more than 4,300 royal projects. They cover almost every conceivable aspect of what is generally labeled "development," but they concentrate heavily on water resources, agriculture, and conservation. The King's projects have long supported the livelihood of small-scale farmers and particularly the rice farmers that constitute the heart of rural Thailand.

His innovations have benefited millions of people, and have given the little people of Thailand the kind of strength that saw them twice deliver record rice harvests, enhancing the country's capacity to export, in the bleak years following Thailand's financial collapse in 1997.

During the massive gatherings in Bangkok to mark the 60th anniversary of his accession to the throne, in June last year, it was a common sight to see mature Thai people weeping unashamedly, overcome with the emotion of sharing the moment with their King. For if there is one characteristic that marks King Bhumibol, and has nurtured the success of his many projects, it is his almost uncanny connection with the common folk, the poor, and the dispossessed.

His landmark Royal Crop Replacement Project, which successfully eliminated opium growing in the country's mountainous north, directly affected the lives of at least 50,000 people, and won the 1988 Ramon Magsaysay Award. Early last year, the United Nations recognized King Bhumibol as "the Development King," and, in October, His Majesty received the first Dr. Norman E. Borlaug Medallion, awarded by the World Food Prize Foundation for individuals at the highest levels of international society who have given exceptional humanitarian service in reducing hunger and poverty.

His efforts to improve the livelihood of his people are never remote or detached. His is a hands-on, sweat, and rolled-up shirtsleeves commitment. He holds patents for a cloud-seeding procedure to make artificial rain, two floating aerators for improving the quality of polluted water, and a process for making bio-diesel.

On the occasion of the 50th anniversary of his accession to the throne, in June 1996, King Bhumibol accepted the first and only International Rice Gold Medal awarded by IRRI in recognition of his passionate personal interest in, and devotion to, improving the well-being of rice farmers and consumers. Just over a year later, in September 1997, King Bhumibol recognized IRRI's work and became the Institute's Royal Patron. The Royal Plaque, "the Great Crown of Victory," together with His Majesty's portrait, have since taken pride of place in IRRI's main administration building.

Looking back, it was on 9

June 1946, when his country was still emerging from the Japanese occupation of World War II and was finding peace after having declared war against England, France, and the United States, that Bhumibol became Thailand's King Rama IX. Much of the country was undeveloped; sickness and malnutrition were commonplace. Despite his tender age of 19, it was only a few brief years before his first royal projects began to emerge.

The first involved public health, including a laboratory to produce BCG vaccine to combat tuberculosis, a plant to refine intravenous saline, and a Red Cross river barge dispensing mobile medical help from the banks of the country's rivers. At first, they were funded from the King's own pocket, but a campaign was launched for public donations, so he could do more.

Soon, the projects assumed the distinctive nature of physical, social, and economic development, driven by His Majesty's often-expressed conviction that to be strong and independent, Thai people should first be self-sufficient. First, His Majesty was given a gift of *Tilapia* fingerlings by the emperor of Japan. He raised them in a pond, then had them distributed to village and district leaders so they could be farmed as an alternative source of protein. Then he donated bulldozers for a road development project, and later proposed construction of a dam to supply irrigation water to a district in Prachuap Khiri Khan Province. And so the projects grew. However, individually, they never assumed a grand, sweeping scale. King Bhumibol insists that such work should never "attempt to overhaul the whole system," but rather, development should be taken one small step at a time.

KING BHUMIBOL greets former IRRI Director General Ronald Cantrell during an August 2004 visit to update His Majesty on IRRI's work.

OFFICIAL PHOTO

THE KING said: "If there is any land where rice can grow, then it must be grown." Her Royal Highness Princess Maha Chakri Sirindhorn heeds her father's words by transplanting rice on a vacant plot of land at Chulachomklao Royal Military Academy in Nakhon Nayok Province in 2001.

THAILAND RICE RESEARCH INSTITUTE

Now, after more than half a century, there are so many royal projects, and their scope is so broad, that to refer to them individually is virtually impossible. They are grouped under headings: agriculture, animal husbandry, crop substitution, education, fisheries, irrigation, land development, medical, personal, rain-making, river basin development, road development, and watershed development.

Some of them involve only study, and are intended to fully inform His Majesty of social and physical parameters, so that development guidelines can be written. Others relate directly to solving problems faced by the people. Some are based on His Majesty's own experimentation, and are funded from his private resources. In other cases, the King gives advice and guidelines to private-sector projects, while in many other cases His Majesty plans and advises government agencies in the study and implementation of development work.

His Majesty championed vetiver grass as a means of stabilizing erosion-prone land, and his advances in the difficult field of artificial rain-making have led to the formation of a year-round cloud-seeding force with 45 aircraft flying from 12 bases around the country, bent on avoiding drought.

It may be easy to assume that, since he is the King, what he says will happen. It is not that simple. He is a constitutional monarch and, as such, can only give advice. Nevertheless, his moral authority is monumental. Still, his initiatives must be feasible and complement government policy, and each is judged on these bases before adoption. Directing, coordinating, and monitoring the vast development network is the Royal Development Projects Board, whose office is a department within the Office of the Prime Minister.

The nature and purpose of the projects are guided by the King's pronouncements, many of which established clear principles that, some years later, were to become accepted practices for the

BOB HILL

PALACE WORKER Akkhradat Kuamklang shows charcoal tubes made from compressed rice husks in an experimental plant on the grounds of Bangkok's Chitralada Palace.

wider international development community. Some examples are

"Understanding the situation facing those we want to help is most important. Helping them to acquire the basic needs of life is the most effective means of assistance. Therefore, in each case, before giving assistance, we must take account of their wants and needs. We must understand the situation they are encountering and decide the means and extent to which they can be helped. We should also adhere to the important principle that we help them in order to enable them to help themselves."

"Providing occupational assistance to farmers to enable them to be self-supporting is crucial because once they become self-supporting, they will certainly be able to build up a higher level of development. In undertaking the step-by-step approach to development, it is significant to promote caution and economy, to protect against failure, and to ensure full success."

"It is not necessary to promote agricultural production only in terms of quantity because this may be a waste of production costs and destructive to the quality of the soil. In fact, we should examine the state of the agricultural market, including some form of price regulation, to prevent farmers from being affected by price fluctuations."

"Development must take account of the topographical and sociological environments involved. The sociological environment means the habits and attitudes of the people. We cannot force others to think in the same way as we do. We can only approach, and suggest. We cannot offer assistance by expecting them to think the same as us. When we approach them we must learn what their real needs are, and explain to them how they can best achieve their aims and how the principles of the development plan can be successfully applied."

Explaining those principles became the driving force behind a unique "show window" on the royal projects launched in the early 1980s. His Majesty established six Royal Development Study Centers, scattered throughout the country and catering to the different climatic and environmental conditions of the country's different regions.

The centers set out to be "living natural museums," bringing together and integrating the innovations, techniques, and systems developed over decades of experimentation, research, and trial. The doors of the centers are open to anyone wishing to learn. People in each of the regions can observe models of modern knowledge and technology, which they can then apply on their own farms. Likewise, students and researchers use the centers, which have become popular meeting-grounds for scientists, bureaucrats, nongovernmental organization workers, and ordinary people, from district and village officials to farmers, housewives, and school children.

Of particular emphasis in the study centers is the King's concept of sufficiency economy. Originally called "The New Theory," it aims to promote sustainable self-sufficiency on small farm holdings by combining organic rice, vegetable, and fruit growing with fish and livestock production. It preaches full integration of farming systems and careful resource management. His Majesty urged farmers to adopt the system following the Asian financial disaster in 1997, and many have successfully taken it on.

Although many of the royal projects have been aimed at agriculture in general, some have involved rice growing in particular. His Majesty established a rice bank, from which farmers can borrow, either for seed or for family consumption. In a drive to provide a greater range of rice varieties for farmers in the country's diverse environmental zones, different varieties were evaluated under different growing conditions.

Soil fertility studies have also been aimed at rice farming problems, particularly declines in irrigated rice yields and the effects of acidity and salinity, but also at developing composting techniques to support organic rice farming, with an emphasis once more on

WORLD FOOD PRIZE

THE DR. NORMAN E. BORLAUG Medallion, awarded by the World Food Prize Foundation for individuals who have given exceptional humanitarian service in reducing hunger and poverty. King Bhumibol was the first-ever recipient in October 2006.

self-sufficiency. One royal study even discovered that a rat infestation problem afflicting one group of rice growers was a direct result of a local habit of killing and either eating or selling snakes, thereby disrupting the natural biological balance in the area.

His Majesty maintains a close interest in the work of both Thailand's rice science community and international rice research, and regularly speaks out against farmer pessimism for the future of rice growing.

"If someone says it is nonsense to grow rice—that it brings poor returns—then just think: if we do not grow rice, we will end up having to buy it from Vietnam or Burma (Myanmar)," the King said. "If we buy from Vietnam, we will have to pay for transportation and give profits to someone else.

"Thailand must grow more rice because in another 20 years we may have 80 million people and, without enough rice, there may be disagreements among the Thai people. Even if the quality of Thai rice is not as high as that in other countries, we must still grow it. And who cares if people say I'm foolish for saying this. If there is any land where rice can grow, then it must be grown. Thais must eat rice, three times a day. Thais don't eat bread—that is just a snack."

In recent years, King Bhumibol's health, as he approaches his 80th birthday this year, has restricted his constant roaming of the Thai countryside and his direct intervention to improve the lives of his subjects. But Her Majesty the Queen Sirikit, the Crown Prince, His Royal Highness Prince Maha Vajiralongkorn, and Her Royal Highness Princess Maha Chakri Sirindhorn are ensuring that the King's work continues. All have their own development projects modeled after those of the King.

HER MAJESTY Queen Sirikit harvests rice from an experimental plot.

THAILAND RICE RESEARCH INSTITUTE

If there is one example that epitomizes the King's extraordinary development work, it is the Chitralada Palace in Bangkok. Hidden from public view behind a moat, tall fences, spreading trees, and armed sentries, it is easy to imagine that within the one-square-kilometer compound are manicured lawns and tropical gardens, ornate statues, ponds and fountains, polo fields, and stables—perhaps resembling the European style of regal grandeur.

The Chitralada compound, in the jam-packed mayhem of downtown Bangkok, is a complex of agricultural stations, model industrial plants, laboratories, and farming experiments. Crowded with workers, the palace has a full-scale dairy farm, a milk-processing and cheese-making factory, a fruit-processing plant, factories producing bio-gas and bio-diesel, a tissue culture laboratory, experimental rice fields, a factory producing charcoal from rice husks, and a germplasm bank. It also has a school for more than 1,000 children of the people who work on the King's projects. And, at its heart is the Chitralada Villa, with King Bhumibol and Queen Sirikit in residence.

Rather than isolating himself within the pomp and ceremony that are the common view of his extraordinary reign, Thailand's Development King—IRRI's Royal Patron—prefers to live at the active heart of a development engine that promises a better future for his 64 million subjects.

KING BHUMIBOL and Queen Sirikit inspect the IRRI agricultural engineering unit during a July 1963 visit.

IRRI

We are grateful for the assistance of the National Rice Research Institute of Thailand in preparing this story.

Bob Hill is a Thailand-based writer specializing in science and technology.

India hosts world's largest

INDIAN PRIME Minister Manmohan Singh presents the M.S. Swaminathan Award for Leadership in Agriculture to former IRRI principal plant breeder Gurdev Khush, with Dr. Swaminathan and IRRI Director General Robert Zeigler (*second from right*) looking on.

D.K. SETH

Each day of the 2nd International Rice Congress (IRC) 2006, delegates from 47 countries crisscrossed through the office block lobby at the impressive New Delhi headquarters of the Indian Council of Agricultural Research's National Agricultural Science Complex (NASC). Here, the global nature of rice was thrown into sharp relief. People from every corner of the globe crossed paths and, more often than not, stopped to chat. Every continent and every major religion on Earth were represented here. And all were drawn together by one simple—but also not so simple—thing: rice.

In total, 1,383 delegates from 46 nations, including host-country India, attended the IRC, which aimed for greater application of rice science and technology, and cooperation among countries to address the problems of poverty and hunger. Almost one-third of the attendees—who included rice researchers, traders, rice millers, farmers, and agriculture ministers—traveled from other countries to make up the largest-ever gathering of rice workers. Participants deliberated on various aspects of rice production, commerce, and international cooperation, with a special focus on the latest research, science, and technology.

The event was inaugurated by the Honorable Prime Minister of India Manmohan Singh at Vigyan Bhawan, New Delhi. During his speech, the prime minister noted that "Despite remarkable achievements, hunger

LEFT TO RIGHT: at an 11 October dinner, retiring IRRI Board of Trustees member Fazle Hasan Abed (*at right*)—founder and executive director of the Bangladesh Rural Advancement Committee—accepts a toast from IRRI Spokesperson Duncan Macintosh and Michiko Otsuka, wife of IRRI Board Chair Kei Otsuka; M.A. Salam, chief scientific officer and head of the Plant Breeding Division at the Bangladesh Rice Research Institute in Gazipur, accepts the 2006 Senadhira Rice Research Award, with Dr. Zeigler looking on; the main building of the National Agricultural Science Complex; a Greenpeace activist—one of several who interrupted a press conference to voice fears about genetically engineered rice—sits beside a bowl of rice containing a symbolic question mark; traditional Indian dancers at the IRC cultural night on 10 October.

IRRI-INDIA OFFICE

rice gathering


International Rice Research Consortium Coordinator Grant Singleton chats with Haryana rice farmer Bhavneet Singh at the IRRI exhibition.

and malnutrition continue to afflict millions and millions of people across the world. About 815 million people in developing countries are reported by the FAO (Food and Agriculture Organization) to be undernourished. Hunger and malnutrition are the underlying cause of more than half of all child deaths, killing nearly 6 million children each year." Dr. Singh said he was confident that the IRC 2006 would help pave the way for a better tomorrow for the rice farmers of the world.

Held on 9-13 October 2006, the IRC incorporated the 26th International Rice Research Conference (at which 900 research papers were presented), the 2nd International Rice Commerce Conference, the 2nd International Rice Technology and Cultural Exhibition (which featured displays from 49 companies, institutes, and organizations from countries including India, the United States, Japan, China, and the Philippines), and the 2nd International Ministerial Round Table Meeting (see *Agricultural ministers come together over rice* on pages 18-19).

The event was sponsored by the Ministry of Agriculture, Government of India; the International Rice Research Institute (IRRI); and the Agricultural and Processed Food Export Development Authority, and was organized by the Indian Council for Agricultural Research and the National Academy of Agricultural Sciences. Special recognition was also given to the organizing team led by Indian Agricultural Research Institute Head Pramod Aggarwal and IRRI's J.K. Ladha.

IRC conclusions

The IRC would be meaningless if it did not promote action. Key recommendations and conclusions included the following:

- Hybrid rice breeding and modification of plant architecture were discussed as strategies to increase yield potential and help meet rice production demand.
- Site-specific nutrient management should be used to minimize nutrient deficiencies and improve rice production with optimum use of the most appropriate fertilizer.
- Climate change is a real threat and adaptation strategies need to be developed. Earlier observed benefits of increased carbon dioxide are smaller than first predicted and could be overridden by the negative effects of increasing temperatures.
- Quality seed is the single most crucial input for securing rice productivity and production. Farmers need access to affordable quality seed of the right variety and at the right time. To ensure this, strong linkage is needed between the private and public sectors.
- There is a need for harmonized international treaties and intellectual property rights that support resource-poor farming communities and nations.
- There is a worldwide need to minimize the average 20% losses caused by diseases and pests. Both biotechnology and effective germplasm exchange have significant roles to play.
- Information and communication technologies are readily adaptable tools that can help increase profitability by offering access to market information and linking smallholders.
- A consistent scientific basis for defining rice quality for export is needed.


ADAM BARCLAY (6)

REPRESENTATIVES from IRRI and the national agricultural research and extension systems (NARES) of 15 countries attended the 10th meeting of the Council for Partnership on Rice Research in Asia (CORRA) on 14 October 2006 at the National Agricultural Science Complex in New Delhi. One of the meeting's key outcomes was CORRA's approval of Vietnam as host of the next CORRA meeting, and a resolution to support efforts for Vietnam to host an international rice research conference in 2007. The annual meeting is the major get-together of NARES heads in their efforts to guide, facilitate, support, and thereby strengthen partnership among NARES, IRRI, and other relevant institutions.

Agriculture ministers come

During the International Rice Congress 2006, nine ministers of agriculture representing China, Indonesia, Laos, Nepal, Pakistan, the Philippines, Sri Lanka, Vietnam, and India made a historic Delhi Declaration at the 2nd International Ministerial Round Table Meeting, in which they stressed the fostering of cooperation among Asian countries to safeguard the environment and food and nutritional security.

The Delhi Declaration

Adopted at the 2nd International Ministers' Round Table Meeting held on 10 October 2006 during the 2nd International Rice Congress in New Delhi, India.

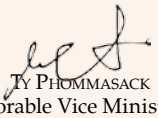
The undersigned ministers and representatives of agriculture:

- Confirming the spirit of the Beijing Declaration following the First Round Table Meeting held on 15 September 2002;
- Confirming our commitment to intellectual property rights as per World Trade Organization stipulations and provisions including indigenously developed improved varieties of rice;
- Stressing the strategic importance of the Asian nations in the production of rice and moved by the will to give their future thrusts a new dimension, based on comprehensive cooperation, in keeping with the privileged nature of the links forged by neighborhood and history;
- Aware that the farmers are facing the challenge of producing more rice at less cost in a deteriorating environment and rice research and development needs to address the Millennium Development Goals on poverty alleviation, food and nutritional security, and environmental conservation in a partnership mode;
- Resolve to establish to that end a multilateral framework based on a spirit of partnership;
- Regarding this multilateral framework as the counterpart to a strengthening of bilateral relations which it is important to safeguard, while laying stress on their specific nature;
- Stressing that this initiative is not intended to replace the other activities and initiatives undertaken in the interests of the peace, prosperity, stability, and development of the region, but that it will contribute to their success;

Hereby agree to establish a comprehensive partnership among the participants through strengthened dialogue on a regular basis for strengthening rice research and development efforts laying greater emphasis on the social, cultural, and human dimensions and IRRI would host a task force comprising experts from all the countries and centers of excellence in the area to prepare a road map for the purpose.

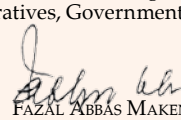
Zhang Baowen
Honorable Vice Minister of Agriculture, Government of the People's Republic of China

Sutarto Alimoeso
Director General of Food Crops, Ministry of Agriculture, Government of Indonesia

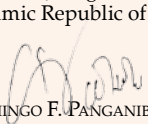


Ty Phommasack
Honorable Vice Minister of Agriculture, Government of Laos

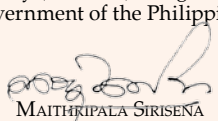
Mahanth Thakur
Honorable Minister of Agriculture and Cooperatives, Government of Nepal



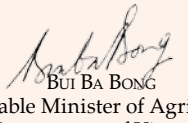
Fazal Abbas Maken
Minister (Trade), High Commission for the Islamic Republic of Pakistan



Domingo F. Panganiban
Secretary (Minister) of Agriculture, Government of the Philippines



Maithripala Sirisena
Honorable Minister of Agriculture, Irrigation, and Mahaweli Development, Government of Sri Lanka



Bui Ba Bong
Honorable Minister of Agriculture, Government of Vietnam

Shri Sharad Pawar
Honorable Union Minister of Agriculture, Consumer Affairs, Food, and Public Distribution, Government of India

together over rice

SHRI SHARAD PAWAR, Minister of Agriculture, Consumer Affairs, Food, and Public Distribution, Government of India (*left*), talks with Indian Prime Minister Manmohan Singh at the IRC inauguration at Vigyan Bhawan, New Delhi.

D.K. SETH

MINISTER PAWAR outside the National Agricultural Science Complex with Mangala Rai, director general of the Indian Council of Agricultural Research and chair of the organizing and advisory committees of the IRC.

IRRI-INDIA OFFICE (2)

LED BY Minister Pawar, the ministers of agriculture of China, Indonesia, Laos, Nepal, Pakistan, the Philippines, Sri Lanka, and Vietnam, together signed the Delhi Declaration on 10 October 2006.

Southeast Asia endorses major initiatives to boost regional rice production

Rice production in Southeast Asia—arguably the region's most important industry—has received a major boost with the endorsement of three new strategies by the Ministers of Agriculture and Forestry of the ten-nation Association of Southeast Asian Nations (ASEAN).

The International Rice Research Institute (IRRI) implemented and coordinated the new measures, which are aimed at three major challenges facing rice production in ASEAN: protecting the environment, ensuring that rice farmers receive the latest knowledge and information, and developing the next generation of rice farmers and scientists.

Specifically, ASEAN has endorsed the development of a series of environmental indicators for rice production focused on production, biodiversity, pollution, land degradation, and water; the further development of the Rice Knowledge Bank for rice farmers (www.knowledgebank.irri.org), Asia's first digital extension service in agriculture; and the development of rice camps for young Asians to encourage them to consider a career in rice.

The decision to endorse the three new activities was made at the 28th meeting of the ASEAN Ministers of Agriculture and Forestry in Singapore on 16 November 2006. ASEAN includes Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

"To have ASEAN member countries endorse these very important activities at the ministerial level is obviously a crucial step forward, and we are very grateful for such high-level political support," IRRI Director General Robert Zeigler said. "With major Asian rice producers such as Thailand, Vietnam, Indonesia, the Philippines, and Myanmar now officially part of these activities, we hope to reach out to other countries in Asia—especially China and India—for their support also."

RICE FIELDS in Albay Province, Bicol, stretch out to the foothills of Mayon Volcano when it was threatening to erupt in July 2006. Six days after Typhoon Durian struck, the scene (*right*) is very different. The huge mudflow at the right of the photo claimed many lives and obliterated rice fields and homes.

story by Meg Mondoñedo, photography by Ariel Javellana

ONCE WERE

The week after Typhoon Durian slammed into the Philippines' Bicol Region, Rice Today *ventured into the stricken area to find that the rice-farming communities had been hit hard.*

THE REMAINS of a house in San Isidro, Albay, perch precariously over a ditch fashioned by the river of mud, rocks, and volcanic ash that carved through the region.

The road to Albay from the Los Baños headquarters of the International Rice Research Institute (IRRI) is long but not tedious. After 12 hours of driving through town after town of busy markets lined with *parol* (Christmas lantern) vendors, deep green coconut plantations, quiet rice fields, and shimmering blue coast, the landscape gave way to a city of darkness and desolation—Legaspi in Albay Province, Bicol, Philippines. Five days earlier, Typhoon Durian (locally known as Reming) had struck the region, bringing winds upward of 220 km per hour and leaving hundreds dead, missing, and homeless.

Children are in the streets, barefoot and begging, the houses behind them destroyed. Everywhere, people are digging, either to rebuild homes or find missing relatives. With no power, no water, and roads that have collapsed into

A GROUP of children pose in front of rice fields in Santo Domingo, Albay Province, in happier times in 2001. John Oliver Leron (*below*) sits in the same area after Typhoon Durian triggered the devastating mudslides.

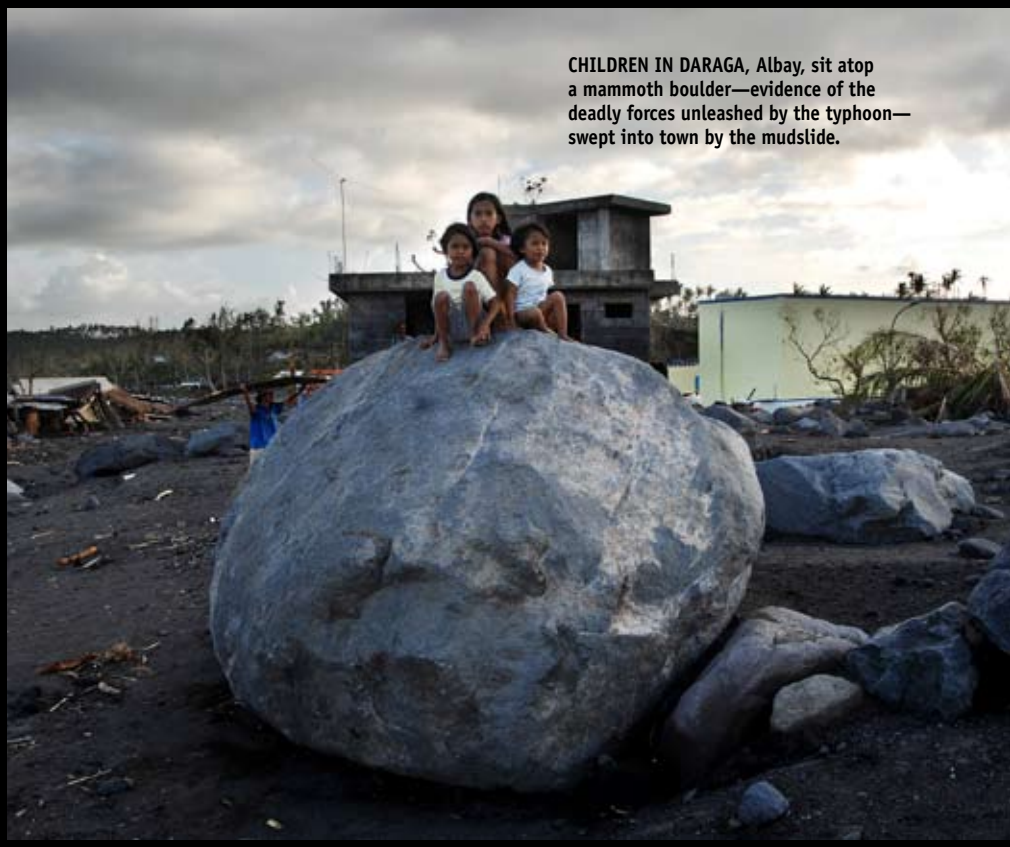
AL BENAVENTE

RICE FIELDS

rivers, *Rice Today* set out to find the rice farmers who live at the foot of Mayon Volcano in Albay.

It has been a difficult year for Albay, to say the least. Only a few months previously, Mayon was threatening to erupt (see *Rice in harm's way* on pages 24-27 of *Rice Today* Vol. 5, No. 4). The volcanic activity died down, and but then Durian did what the volcano, this time, couldn't. The intense typhoon rains dislodged the tons and tons of volcanic ash, creating massive landslides that obliterated houses and rice fields and, as *Rice Today* went to press, killed more than 400 people, with at least that many still missing.

Here, *Rice Today* brings you images and stories that offer a glimpse of the terror that Durian blasted into the lives of some of the Albay rice-farming families, as well as the despair and hope that the typhoon left behind.



CHILDREN IN DARAGA, Albay, sit atop a mammoth boulder—evidence of the deadly forces unleashed by the typhoon—swept into town by the mudslide.

Ariel Javellana. 6 December 2006

30 November 2006: Typhoon Durian triggers deadly mudslides that swallow entire rice farms in Albay Province, Bicol, Philippines.

RICE FARMER Gloria Miranda's house at the foot of Mayon Volcano was threatened by lava flows in July 2006 and (*right*) half-destroyed by Typhoon Durian in November 2006.

Gloria Miranda, 51

Gloria lives with her partner and their teenage daughter, Fanela. Durian destroyed most of her crops and more than half of her house (see photos above), and killed her farm animals.

We just stayed inside the house from 9:30 a.m. to 5 p.m. We couldn't go out because the rain was so hard. All our things got wet.

We will plant again, start over, and raise animals again. We're not leaving. It's hard to evacuate because this is our home.

As long as we have rice, fish sauce, dried fish, and water, we'll be ok.

Sofroneo "Fron" Rodriguez, 59

In July, Fron and his family were taking refuge from Mayon volcano in an evacuation center. This time, he was taking stock of what used to be his farm and is now a swath of lahar, the black, tar-like mix of ash and mud characteristic of volcanic eruptions.

Many cows, carabaos, and pigs died. I don't know the number, but even the piggery was destroyed. The flood was caused by the mud flow from Mayon.

This is the strongest typhoon I have seen. Good thing my house did not fall apart, but all of my seedlings are dead. Thank God no one died in my family.

Because of the damage, I will lose my income of 5,000 Philippine pesos [US$100] a month unless I can get new seedlings soon. We will have to start over again. Our only source of income is now gone.

I'm thinking of moving my house to a higher place so my family can be safe.

We were safer during Mayon's lava flow. With this typhoon, we lost everything.

RICE FARMER Sofroneo "Fron" Rodriguez.

Two farmers. Two stories. Although they lost so much, Gloria and Fron can count themselves lucky. They and their families are alive and well. As well as losing their fields to mud, rocks, and ash, many others lost loved ones. Thousands are living in evacuation centers and will be there for who knows how long. Hundreds of bodies were buried in mass graves, unidentified.

As *Rice Today* leaves Albay, the smell of rotting garbage and dead animals is at times overwhelming. People's bodies are still trapped beneath the earth. The air is cool, with the tropical "winter" bringing relief from the usual humid heat. It's almost Christmas but not a single *parol* can be seen. Mayon Volcano remains a beautiful sight, its spectacular silhouette rising above the lahar. But, right now, it's hard not to think it's just another disaster waiting to happen.

A SATELLITE photo of Typhoon Durian over the Philippines on 30 November 2006, the day it hit the Bicol region, several hundred kilometers southeast of Manila.

GODDARD SPACE FLIGHT CENTER, NASA

RICE FARMER Oscar Ballaran, whose photo appeared in *Rice in harm's way* (pages 24-27 of *Rice Today* Vol. 5, No. 4), lost his house in San Isidro, Albay. Thankfully, his family was unharmed.

THIS RICE MILL in San Isidro, Albay, is owned by Luis Balilo, 22 (*in white t-shirt*), who is now unsure about when he can resume his milling operations after his one and only mill was buried deep in mud. "I don't know what my plans are," he said. "I'll just open it again when I have the budget." More important to him in the immediate aftermath was the loss of his three German shepherds, who used to guard the mill.

Correction

In *Rice Today* Vol. 5, No. 4, we incorrectly named Oscar Ballaran as Sofroneo Rodriguez. We would like to apologize to both men for the mix-up.

THE LANDSLIDE consisting of mud, rocks, and volcanic ash inundated towns throughout Albay Province.

Strength in Diversity

by Ruaraidh Sackville Hamilton

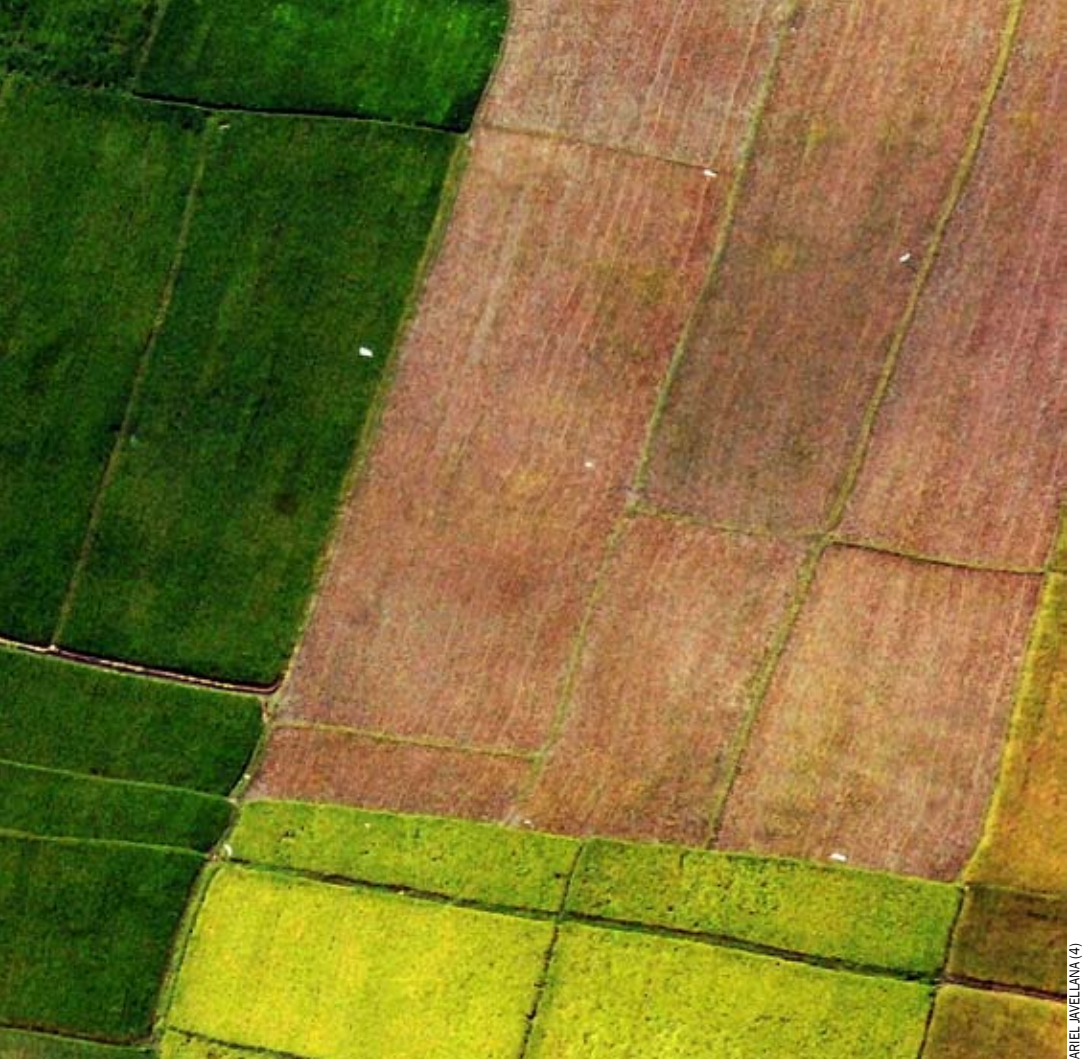
Biodiversity is more than just a nice green concept—farmers rely on it

The loss of biological diversity is one of the most serious environmental problems in the world today. The maintenance of biodiversity in healthy balanced ecosystems is crucial to the survival of life on Earth. Yet, the loss of biodiversity is alarmingly high worldwide. Up to 60,000 plant species could be lost by 2025 if the present rate of extinction is maintained. The Food and Agriculture Organization of the United Nations has estimated that, since 1900, about three-quarters of the genetic diversity of domestic agricultural crops has already been lost.

Rice includes more than 20 wild species and two cultivated species of the genus *Oryza*, with probably well over 100,000 varieties of the cultivated forms. The worldwide loss of biodiversity is also affecting rice biodiversity in all rice-growing countries, especially after the introduction of modern high-yielding varieties of rice from the 1960s onward. In the Philippines alone, where several thousand varieties of rice were grown in the 1950s, only a few varieties now cover the majority of the rice area.

The rice-farmed landscape is more than just rice. It is a patchwork of terrestrial and aquatic habitats. The rice field itself can be rich in biodiversity, with more than 100 useful species associated with it. Rice fields provide habitats for wildlife species, including fish, amphibians, reptiles, crustaceans, mollusks, and insects, besides various aquatic and free-standing plants. Domesticated species, such as ducks and cattle, also make use of the vegetation for their food. A balanced farm also contains a range of other crops, trees, and wild habitats. The rice-field ecosystem has developed over thousands of years: it is dynamic, stable, and sustainable, and has adapted to different environmental conditions in different countries and regions.

The overall impact of traditional agriculture on biodiversity is positive. Traditional farmers have, over 10,000 years or more, created huge amounts of novel and valuable biodiversity. Starting with the unproductive wild ancestors of our crop plants, they



ARIEL JAVELLANA (4)

created new species and new forms far more dramatically novel than anything being produced by modern-day genetic technologies. Imagine hundreds of thousands of farmers, each farmer working to breed better crops, and all with their own perceptions of the quality of product they want, their own distinctive set of constraints (pests, diseases, weeds, soil types, climate) to overcome, and their own parental materials to start breeding with. The result was millions of different varieties of crops, and a huge diversity of crop plants.

Traditional farmers know well the value of diversity on their farms. Many of them grow mixtures of crops or mixtures of strains of one crop, knowing that a mixture suffers less damage from pests and diseases and can produce a more reliable yield from year to year despite the vagaries of weather and rainfall. In some places, farmers deliberately re-constitute mixtures each year. In some places, they use mixtures with overlapping cropping seasons to reduce the length of time that soil remains bare and therefore at risk of erosion.

In contrast to traditional agriculture, intensive agriculture, which requires the use of chemical inputs and uniformity of seed material, threatens this rich biodiversity. Pesticides also kill off the natural enemies of rice pests and remove forms of biological control that occur naturally in a more balanced ecosystem. Runoff of fertilizer and pesticides pollutes groundwater and surface waters, and can cause epidemic outbreaks of algae and the few other wild plant species that thrive on nitrate-polluted water. Rice breeding by large multinational corporations is economically more profitable if based on a small number of mega-varieties that dominate the marketplace and achieve widespread adoption. Legal restrictions protecting plant breeders' rights in many countries dictate that modern varieties must be genetically uniform, unlike the older, genetically diverse, and adaptable farmer-bred varieties that they replace. In some countries (but, as of now, few rice-growing countries), those restrictions also prohibit farmers from saving their own seed for sowing the next year's commercial crop, thus forcing them to choose from the comparatively small number of modern varieties and destroying the traditional farmer-breeding system on which the whole of agriculture is based.

At the landscape level and above (regional, national, global), the need to devote an increasing percentage of the landscape to agriculture in order to feed an increasing world population per se reduces biodiversity. There is

just less and less land available for nonfarmed ecosystems. The conversion of rare and threatened habitats to farmland is causing a major continuing loss of biodiversity.

Thus, modern intensive agriculture has reversed the trend of increasing biodiversity under traditional agriculture. This is often cited as one of the key factors driving the loss of biodiversity.

In many places, rice farmers grow a range of crops for special purposes—one rice variety that is ideal for rice wine, another for a dish used in religious rituals, another that grows particularly well in that shaded field at the bottom of the valley, a set of varieties with differing maturity dates to spread the labor of harvesting, a small plot of a particularly early-maturing variety to avert a period of hunger, and so on.

Although rice is impressively diverse, it is a complex issue to speculate whether rice is more or less diverse than other cereal crops. It is believed that rice was domesticated at least twice in Asia, independently by farmers in China and the southern Himalayan belt, from different ecotypes of *Oryza rufipogon*. The mixing of the two primitive types has generated loads of diversity. Recent estimates of the date of domestication make it older than other crops too, so there has been more time for diversity to evolve.

On the other hand, rice is quite possibly no more diverse than other crops. Compared with wheat and potatoes, for example, cultivated rice is relatively close to its ancestral wild form and so hybridizes quite readily with its wild relatives. One can therefore find almost a continuum of variation along the wild-weedy-cultivated forms. In contrast, cultivated maize and wheat have become so distinct that it's very difficult to hybridize them with their wild relatives. In fact, maize is so distinct that it took a lot of effort just to identify its closest wild relative.

In theory, the same principle applies to all crops—their forms and traits are shaped by a balance among natural selection for fitness, farmers' selection for productivity, and distinctive selection pressures by different farmers with different preferences. All these selective pressures contribute to a rich crop biodiversity.

Landscape management is another key factor affecting biodiversity, either positively or negatively.

As a broad generalization, one can state that individual choice and small enterprises in landscape management tend to be more beneficial to biodiversity than centralized control and large businesses.

Individual choice and small enterprises result in different management decisions being made on different parcels of land. This in turn leads to a diverse patchwork landscape in which no one ecosystem dominates. The choices can be different drainage, a different balance between managed and unmanaged parcels, and a different balance between farmed parcels and parcels managed for nonagricultural use such as orchards, timber, tourism, and aquaculture. As long as diverse choices are made, the landscape will be diverse.

Centralized control and large businesses tend to result in similar decisions being made over large tracts of land. Even if the business is for ecotourism, sustainable forestry, or other environmentally friendly purposes, the impact on biodiversity can be negative at the level of the whole landscape.

Increasing population density also amplifies the degradation of biodiversity, as more and more land must be taken under cultivation or used for houses, factories, shops, and roads. Wealth helps mitigate the loss of biodiversity. People stuck in the poverty trap may regard loss of biodiversity as the least of their troubles. Poor governments likewise may place biodiversity low in their development priorities.

Generally, the more complex the interactions between organisms and their environment, the more varied the surrounding environment and, in turn, the greater the biodiversity.

To an extent, one can say that almost every natural process promotes biodiversity in some way provided it involves events or states that persist for long enough to affect

Improving productivity through biodiversity

On farms, biodiversity of the farming system itself can be diversified in many ways to improve productivity:

- Mixtures of crops or mixtures of varieties of one crop can dramatically reduce the instance of diseases, in some cases even from near total failure of unmixed crops to almost no detectable disease in mixtures.
- Mixtures of crops, or different varieties of one crop, with different adaptation to temperature and rainfall can increase the reliability of yield in the face of climatic uncertainties from year to year.
- Planting different fields to different crops or different varieties that differ in their harvest date can spread the harvesting period over a longer period of time, giving farmers time to obtain a bigger total harvest.
- Sequentially planting different crops in the same field can reduce soil erosion by reducing the duration of bare, unprotected soil.
- Mixing products with complementary resource requirements—such as rice and fish—can dramatically increase productivity compared with keeping them separate.

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the life around them. Every stream, every death of an insect, every strike of lightning, and every rice plant create around them a distinctive set of environmental conditions that are favorable to the survival of some organisms and unfavorable to others. Even a sulfur-laden hot water spring by a volcano, while killing most forms of life, provides the conditions for a particularly distinctive ecosystem of sulfur-loving and heat-loving organisms. Even large-scale events such as El Niño or the North Atlantic Current create distinctive niches favoring the survival of a distinctive set of species.

Although a catastrophic event like a volcanic eruption may destroy all biodiversity under the eruption, in the longer term, this results in the creation of new types of habitat with distinctively fertile soils in which new forms of life appear.

Agricultural intensification during the 20th century was based on reducing biodiversity, but it is not clear whether or to what extent increasing biodiversity per se might reduce productivity. In theory, by judicious selection of the appropriate components of a biodiverse system, we can promote productivity sustainably.

Biodiversity of both the farmed and unfarmed areas of the landscape can positively affect agricultural productivity in many ways. Certain forms of animal life can benefit a crop because they act as natural enemies of the pests and diseases of the crop.

These natural enemies may have their primary habitat outside the crop itself, and so rely on the presence of other forms of biodiversity, which can be in various places such as the ecosystem of a healthy soil under the crop, nonfarmed ecosystems adjacent to the crop, the weed flora growing with the crop, adjacent fields of other crops, and adjacent plots of other managed systems such as aquaculture, orchards, or timber trees.

The mechanisms by which biodiversity can promote productivity (see *Improving productivity through biodiversity*, opposite) depend on environmental heterogeneity. Yet, intensive agriculture usually reduces environmental heterogeneity to produce a uniformly optimal environment for high productivity—we plough the field to get a uniform seedbed, we level it for efficient irrigation, we fertilize the field to make it uniformly fertile throughout, we weed the field to keep it uniformly free of weeds, and we spray for a field that is uniformly free of pathogens and pests. Moreover, with mechanized harvesting, we need the mature seed to be presented to the harvester on the same day at the same height with the same ease of threshing. To the extent that we are successful in maintaining the uniformity of these components of the environment, a system that is diverse for response to those components is likely to be less productive than one that is a uniform optimal fit for those conditions. Despite appearing to be at odds, rice production and biodiversity conservation can coexist (see *Balanced on a wing* on pages 34-36 of *Rice Today* Vol. 5, No. 3). The necessary basic research centers on two key underlying issues.

The first issue is the relationship between diversity and productivity. This encompasses a whole set of related issues concerned with the different elements of diversity and the different components of productivity—particularly the stability, resilience, sustainability, and reliability of production in diverse systems. There is no generalized relationship between diversity and productivity, but, by choosing the appropriate components, we can build diverse systems that are stable, resilient, sustainable, and reliable.

The second issue covers the social aspects of biodiversity in agriculture—how communities can base productive agriculture on diversity, and how extension officers, agricultural scientists, and policymakers can refocus their outlook to help base sustainable development on diversity.

Applied agricultural research is playing an increasing role by taking ecological and evolutionary expertise and applying it to understanding the dynamics of the farmed and interacting nonfarmed components of a farmed landscape. The "nonfarmed" components have to include not only the organisms that reduce productivity—pests, diseases, and weeds—but also those that are beneficial to the farm economy—natural enemies of harmful organisms and their primary habitats.

Dr. Sackville Hamilton is head of the International Rice Research Institute's T.T. Chang Genetic Resources Center.

This feature story is adapted from an article originally published on GreenRice.net (www.greenrice.net).

In search of NEW SEEDS

The improved New Rice for Africa varieties are helping not only African grain farmers but seed producers as well

by Savitri Mohapatra

It is said that if you want to be a good gardener you should always sow three seeds: one for the bugs, one for the weather, and one for yourself. But if you tell this to Seybou Lema, who produces and sells seeds of the New Rice for Africa (NERICA) in the West African country of Togo, he wouldn't agree to waste even a single seed.

TOGO FARMER Seybou Lema inspects his NERICA seed crop

Seybou doesn't want to be just a good farmer; he wants to be efficient as well because the happiness of his entire family depends on the quantity and quality of the NERICA seeds he produces. The NERICA varieties, which are bringing hope to millions of poor people in Africa, were developed by the Africa Rice Center (WARDA) and its partners.

"With the money I got from selling NERICA seeds, I bought food, paid school fees for my children, and bought clothes for them," Seybou said. "I have also used the cash to extend our house," he added, proudly showing the new extension made of concrete, next to his hut.

Seybou belongs to a new breed of African rice farmers trained in seed production techniques as part of a program on a community-based seed production system (CBSS) that was introduced by WARDA and its partners as an integral part of the NERICA dissemination program.

In sub-Saharan Africa, seed production and distribution are major bottlenecks to the dissemination of new crop varieties. A study conducted by WARDA economists in 2005 found that only about 30% of rice farmers interviewed were growing improved high-yielding rice varieties because of a severe shortage of seed.

The main reason for the seed shortage is that national seed systems lack the staff, equipment, and funding to assure farmers an adequate supply of quality seeds on a regular basis. To overcome this problem, CBSS trains farmers on how to produce good seed for their own use, and to exchange or sell excess seed to other farmers. A major advantage of CBSS is that it shortens the time required for seed of improved varieties to reach farmers.

CBSS-trained farmers, such as Seybou, are now quietly changing the rice scenario in sub-Saharan Africa, where farmers traditionally save, exchange, and use rice seeds from one harvest to the next or, in times of shortage, buy rice paddy from the market to use as seed.

Even for Seybou, it was difficult to accept at first that one could sell seeds. But, when he found out to his great amazement how much money he could make by selling NERICA seeds, he abandoned cotton farming and began to devote all his time, effort, and land to NERICA seed production.

Seybou started NERICA seed production on half a hectare in 2004 and gradually increased the area to 6 hectares in 2006. "But I am still unable to cope with the demand for seed from farmers of neighboring villages," he told a delegation from the African Rice Initiative.

The African Rice Initiative is particularly interested in NERICA seed production because it was established to scale up the dissemination of NERICA and complementary technologies across

SEYBOU LEMA with his family.

R. RAMAN, WARDA (3)

sub-Saharan Africa through a coordinated effort. The Initiative has been actively involved in the production of NERICA foundation (basic) seed as well as in the training of extension staff and farmers in seed production, with the support of many partners and donors, including the African Development Bank, Rockefeller Foundation, Japan International Cooperation Agency, and the United Nations Development Programme (UNDP).

In 2005, a US$35 million 5-year project was launched by the African Development Bank to support NERICA dissemination in seven West African countries—Benin, Ghana, Guinea, Mali, Nigeria, Sierra Leone, and The Gambia. About 80% of the targeted beneficiaries of this project, which is coordinated by the African Rice Initiative, are the rural poor, mostly women.

The project estimates that by the 5th year, about 33,000 farm families will be involved in participatory varietal selection, a process in which farmers and breeders work together to choose new varieties best suited to the farmers' needs (see *Taking part* on pages 22-26 of Rice Today Vol. 3, No. 2). Many of them will also be involved in CBSS to accelerate NERICA dissemination.

"The African Rice Initiative and WARDA are exploring with relevant partners, particularly the national systems, to put in place sustainable NERICA seed production and delivery strategies," says Inoussa Akintayo, ARI regional coordinator, who is based at WARDA.

The demand for NERICA seed is not restricted to West and Central Africa. In fact, the biggest surprises are emerging from Uganda, Kenya, and Tanzania in East Africa, where NERICA was introduced just 4 years ago.

NERICA's potential as a cash crop has captured the attention of Uganda's seed companies. This is partly explained by the fact that rice is considered more of a cash crop than a food crop in East Africa in contrast to West and Central Africa.

Subsistence farmers are also seeing the positive impact of commercial NERICA seed production in Uganda. "The new rice has changed our living," says one Ugandan farmer. "Our incomes have increased. We have bought clothes, a house, and a bicycle."

At present, targeted NERICA seed production and distribution projects across sub-Saharan Africa are supported by many donors and international nongovernmental organizations, including Japan, UNDP, Rockefeller Foundation, the African Development Bank, Canadian International Development Agency, International Fund for Agricultural Development, World Bank, Food and Agriculture Organization of the United Nations, Sasakawa-Global 2000, Centre Songhai, and World Vision International.

To overcome problems of poor rice seed quality and health, an initiative to scale up technology transfer of good seed production techniques using video has been launched by an International Fund for Agricultural Development-funded WARDA project in Mali, Guinea, The Gambia, and Ghana. Rice seed health videos produced by the International Rice Research Institute, CABI, Countrywise Communication, and the Rural Development Academy Bogra in association with rural women in Bangladesh are being shown to African rice farmers to enable them to learn from their Asian colleagues.

"We are getting these videos translated into French and local languages in close association with our national and local nongovernmental organization partners," says WARDA Technology Transfer Specialist Paul Van Mele. "In Guinea, where NERICA has been widely adopted, these videos have reached thousands of farmers in less than 6 months, contributing to better seed quality of local and improved rice varieties."

MOTHER-AND-DAUGHTER rice farmers Affiwa (*right*) and Conforte Kagnivi with their seed crop in Deve, Benin.

Fighting Asia's postharvest problems

by Trina Leah Mendoza and Martin Gummert

The fate of rice after harvest is a crucial but often-neglected part of the production chain. Now, a major effort to overcome postharvest problems is gaining momentum.

If you're a rice farmer anywhere in Asia, you are likely to experience high postharvest grain losses. Total losses from harvest to market can reach 30–50%, which means that, conservatively, farmers are losing around US$30 per ton of rice harvested. For an average four-member farming family, an additional $30 can go a long way.

Studies by the International Rice Research Institute (IRRI) in Cambodia, Indonesia, and the Philippines have found that postharvest losses occur mainly because of spoilage and wastage at the farm level, delay in drying, poor storage, poorly maintained or outdated rice mills, and losses to pests throughout the postharvest chain. These losses result in lower quality rice for consumption or sale, smaller returns to farmers, higher prices for consumers, and greater pressure on the environment as farmers try to compensate by growing more rice.

With the urgent need to solve postharvest problems in developing countries, the Postproduction Work Group (PPWG) was formed in 2003 by the Irrigated Rice Research Consortium (IRRC). By the end of its first year, the PPWG had established partnerships in Cambodia, Indonesia, Lao PDR, Myanmar, and Vietnam. The PPWG's key objectives are to increase farmers' incomes through improved postharvest management and technology, and build a network of trained postharvest researchers and extension workers in both the public and private sectors.

A plastic storage bag developed at IRRI is one example of postharvest technology that is already making a difference. Farmers in Battambang Province in Cambodia consider this hermetic "super bag" an inanimate superhero in its own right. Typically, farmers store three bags of seeds with 70 kg each for their own fields. The hot, humid conditions cause the germination ability of the seeds to drop quickly. When farmers finally use the seeds after 5–6 months of storage, often less than 50% germinate in the fields. By comparison, farmers who used the super bag to store seeds maintained germination rates above 90% and thus reduced the amount of seed required.

The super bag allows cereal grains and other crops such as coffee to be stored safely for periods of 6–12

COMMERCIAL furnaces, like this one in Long An Province, Vietnam, with a 4-ton reversible airflow paddy dryer, ensure high-quality produce.

MARTIN GUMMERT

TRAINEES in Lao PDR manually harvest paddy.

GEERT CLAESSENS

months. One farmer reported that he sold an additional 70 kg of seeds in the market, earning him an additional income of $9. A super bag costs only $1 and, as long as it is not punctured, can be reused, cutting back on cost per harvest.

The PPWG now focuses on evaluating hermetic storage systems with farmers (Indonesia, Vietnam, Cambodia, Lao PDR, and Myanmar) and rice millers and traders (Vietnam, Myanmar, and Indonesia). Samples from farmers' trials taken for milling and trials with rice millers have proven that hermetic storage also increases head rice (grain fraction that has at least 75% of the whole undamaged kernel length) recovery significantly.

One of the main culprits for deterioration in seed quality is delayed or improper drying, especially when rice is spread in the open to dry under the sun. Mechanical dryers— another PPWG focus—are the best way to ensure high-quality products, especially in the wet season, with its frequent rains and high relative humidity.

At Nong Lam University in Ho Chi Minh City, Vietnam, the PPWG trained dryer manufacturers from Lao PDR, Myanmar, and Cambodia in manufacturing and performance testing of dryer components. A manufacturer in Lao PDR who attended the training subsequently built low-cost, farm-level dryers that he plans to demonstrate and promote in key provinces throughout the country. In Cambodia and Vietnam, farmers' groups and cooperatives are now installing their own flat-bed dryers.

Another training participant, from the Myanmar Rice and Paddy Traders Association, produced various dryer prototypes, including a low-cost dryer with a 1-ton batch capacity for the farm level and flat-bed dryers with up to 4-ton batch capacity for the commercial sector. The Association—which has installed eight flat-bed dryers at rice mills and five others for farmer groups—now visits different provinces in Myanmar to demonstrate the dryers to farmers and millers.

Although they offer major advantages, mechanical dryers add cost to the drying process. To minimize drying cost, the PPWG helped develop a new rice hull furnace in Vietnam as an alternative to the kerosene burners used in most rice dryers. The PPWG also assists national partners in continuous adaptation of drying systems to local conditions and farming systems to provide appropriate drying technology options for farmers, traders, and rice millers, and to help manufacturers produce commercially viable machines.

As the old saying goes, knowledge is power. For farmers, knowledge on up-to-date market information enables informed decisions on what to produce, where to sell, and the best quality grade for maximizing returns from rice harvests. Farmers' knowledge on markets and paddy quality also puts them in a better negotiating position when they deal with local middlemen.

In a project funded by the Asian Development Bank and the IRRC, extension workers in Vietnam and Cambodia collect market information in different villages and provincial and national capitals. In four pilot villages in Vietnam and eight in Cambodia, village market boards have been displayed to keep farmers informed about market information. The PPWG also collects baseline and annual data on rice markets in Lao PDR, Indonesia, and Myanmar.

Determining moisture content is the most critical aspect in maintaining rice grain quality. Unfortunately, most commercial

FARMERS and extension officials test the low-cost moisture meter on rice stored in a super bag in Hau Thanh Village, Vietnam.

MARTIN GUMMERT

moisture meters are priced steeply at more than $200. IRRI has developed a low-cost moisture meter that costs only $30–50 (depending on where it is purchased). These moisture meters have been distributed by the PPWG to pilot villages in Cambodia and Vietnam, and to partners in the national agricultural research and extension systems, where farmer groups can easily share them for their postharvest management decision making.

In addition to its achievements to date, the PPWG has developed country-specific training programs in 2006 and will continue in 2007 in an effort to further promote information exchange among countries. Training materials and postproduction e-learning courses (conducted online or via CD) are being translated into different languages, beginning with Vietnam and Cambodia. National outreach programs such as the Prima Tani program in Indonesia will be bolstered to include postproduction technologies and management options. Dissemination of market information through modern information communication technologies will be pilot-tested in some Cambodian villages.

This story is adapted from an article of the same name on pages 1-2 of Ripple *(Vol. 2, No. 1)—the newsletter of the International Rice Research Consortium (www.irri.org/irrc).*

Trina Mendoza is a communication specialist with the Irrigated Rice Research Consortium. Martin Gummert, a postharvest specialist in IRRI's Grain Quality, Nutrition, and Postharvest Center, is facilitating the Postproduction Work Group of the IRRC.

Prosperity, Pollution, and the Green Revolution

story and photos by Greg Fanslow

The Green Revolution in Indonesia delivered more rice but also brought social and ecological problems that, almost 40 years later, still affect people's lives—but solutions are emerging

The logic of the Green Revolution—spurred by the introduction of modern high-yielding crops in the 1960s—was that food security was the most important factor in social development. That logic paid off with food supplies that have outpaced the dramatic population growth and urbanization across Asia for the last 30 years.

The fertile lowlands of Java are hardly new to intensive agriculture and the Green Revolution in East Java didn't change the landscape as radically as in other places. The rich volcanic soils and large floodplains of Java have lent themselves to intensive agriculture since at least the 14th century, when the two-century reign of the Hindu Majapahit Empire began. At its peak, this empire controlled an area larger than present day Indonesia, with its success largely attributed to irrigated agriculture in East Java's lowlands.

By the 1960s, with Indonesia now a republic, Java continued to be the country's rice basket, producing about two-thirds of the country's rice on roughly half the nation's rice fields.

However, the Green Revolution would be something dramatically different, even in relatively bountiful Java. In the 1960s, traditional practices yielded about 3 tons per hectare in irrigated lands and 1.25 tons in nonirrigated areas. With the full-scale implementation of the Green Revolution through the BIMAS, or "mass guidance," program, the Suharto regime invested heavily in every facet of rice production. Ultimately, according to David Dawe, an economist with the Food and

RETIRED FARMER Darmono surveys the concrete pipe factory that replaced his rice paddies 2 years ago.

Agriculture Organization of the United Nations (FAO), the new approach roughly doubled production in both irrigated and nonirrigated systems. And, other improvements in postharvest storage and transportation would have meant an even greater increase in rice on the market.

People who had relied on traditional belief systems and local knowledge to direct their crop management were thrust into the modern world. Yields would more than triple in just 25 years, chemical fertilizer and pesticides appeared on the scene, and society joined the global cash economy.

Along with the technical achievements that put more rice in the fields and food stores of farmers, the Green Revolution also brought a social and environmental revolution as higher yields sustained a rapidly increasing population.

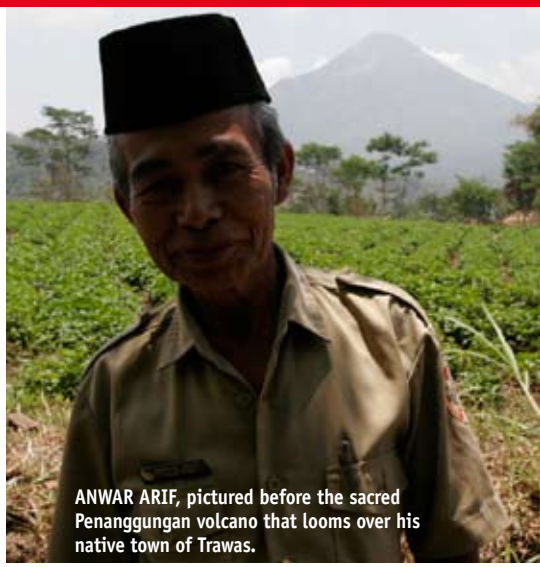
The more-is-better logic of the Green Revolution lent itself to correspondingly simplistic and heavy-handed implementation—especially in Indonesia under the Suharto regime.

Almost 50 years later, things have changed. Although food security was and continues to be the major indicator of overall prosperity, increasing population and urbanization mean that the environmental dimensions of prosperity are important too. In addition to insufficient food availability, overexploitation of resources and environmental damage are also becoming important constraints to human well-being. The unprecedented intensification that came with the Green Revolution brought fertilizers and pesticides and, with them, the potential to dramatically reshape the environment.

Anwar Arif, a civil servant and farmer in the town of Trawas—a small highland town that was heavily marginalized by the Suharto regime—echoed sentiments commonly expressed by agriculturalists in Java. He explained Javanese history in terms of three dominant emotions: confidence during the Sukarno regime (1945-67), fear during the Suharto regime (1967-98), and confusion under the current young democracy.

"Under Sukarno," explains Anwar Arif, "the local governments were strong and had relatively free reign to make policies and decisions that were rooted in local traditions. Production wasn't high, but people felt a sense of confidence that their local leaders were aware of their needs and people tended to trust that recommendations were appropriate.

"Under Suharto, the power of local leadership structures was viewed as a threat to economic development by the stridently anticommunist government. The regime aggressively replaced local leadership structures with centrally controlled decision making."



ANWAR ARIF, pictured before the sacred Penanggungan volcano that looms over his native town of Trawas.

As food security became a major concern during the Suharto years, the government's BIMAS program replaced traditional ways of passing knowledge between generations with networks of scientists and agricultural extension (training, technology transfer, and communication) workers. This era was characterized by dramatically higher yields, but with the high social costs of a poor human rights record and a sense of loss of cultural identity among many farmers.

While the government may have officially allowed farmers to choose which crops and varieties to grow, Anwar Arif and others say that resistance to abandoning

A FARM WORKER gathers seedlings for transplanting into irrigated terraces just outside the town of Trawas in the East Java highlands.

Solving a rural pollution puzzle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Pollution in the rice-farming town of Kota Batu, in the highland district of Trawas, epitomizes many of the pollution issues faced in the Javanese countryside. More than a generation ago, this community was composed mainly of farmers, but things have changed dramatically over the last 40 years.

Development has brought agricultural surpluses and access to markets. Now, within a few hundred meters of the apparently classic rural setting where farmers hoe a dry-season crop of cabbage (photo 1) and a man gathers aquatic invertebrates to feed his chickens (2), there is a surprising degree of entrepreneurial activity normally associated with an urban area. Agricultural pollution from fertilizers and pesticides from farmers' fields certainly contributes to pollution in Kota Batu, but there are other more important sources.

A large population without a proper sanitation system means most domestic waste goes directly into surface water (3). Entrepreneurs have diversified their livelihoods and, in addition to countless small mechanics and blacksmiths (4), some 20 slaughterhouses are processing a combined 3–5 tons of poultry per night (5). Several small factories process several tons of food per day (6). Waste from all of these operations flows untreated directly into canals and streams.

A project funded by the U.S. Agency for International Development's Environmental Services Program supported a community forum known as Fokal Masra to evaluate environmental issues in Kota Batu. The forum identified polluted surface water as a major issue. The project called in the services of Yayasan IDEP, a Bali-based nongovernmental organization, to help residents design and build a "wastewater garden" (7) that uses a settling tank and a series of percolation beds and artificial wetlands to purify water from a small local stream, thus providing residents with a steady flow of clean water for washing and bathing.


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MEN IN the Javanese highland town of Trawas bathe in a spring in the 500-year-old ruins of a Hindu shrine built on the site during the Hindu Majapahit Empire, during which Javanese intensive agriculture was born.

traditional varieties was considered tantamount to insurrection. Efforts to maintain traditional practices were often smothered by excessive use of chemicals or fields of traditional varieties were sometimes burned if discovered.

The outcome of the Suharto era is, understandably, a lot more bad feeling toward the Green Revolution than yield figures alone might suggest.

In the new Indonesian democracy, people are left with the complex and difficult task of recreating the democracy and local responsiveness of the Sukarno era with the production potential of Suharto's technological approach.

"People have to come to grips with a system that is neither rooted in long-trusted tradition, nor prescribed by a central government, and they are like chicks without a mother hen," says Anwar Arif. "The government has realized that a one-size-fits-all approach won't work, but it doesn't have an alternative."

Distrust of the technological approach itself adds further to the confusion. The Green Revolution in Java suffered from an excessive faith in technology to solve agricultural challenges and an ignorance of the complicated ecological and social systems that stabilized the local rice systems. Perhaps nowhere has this shortcoming been more clearly exposed than with respect to pest control.

Under the belief that pesticides could reduce yield losses to insect pests, the government prescribed heavy pesticide use. This led to reduced populations of predators of rice pests and a consequent resurgence of some pests. Entomologists say the brown planthopper, previously unreported as a pest of rice, quickly became a threat to Indonesia's food security. In placing so much faith in seeds developed by scientists, and not enough in farmers' knowledge, the Green Revolution alienated some farmers.

Getting around the one-size-fits-all Suharto approach and resolving

A FIELD worker on a farm in Purwodadi, East Java, pauses during the harvest of a dry-season crop of onions.

Once a farmer

by Duncan Graham

Like many Indonesians, Darmono has only one name. He was born about 64 years ago (he's unsure). He does know he had three formal years in an elementary school and then he was on the land.

But Darmono (*pictured here and on page 34*) is no longer a farmer. Two years ago he reluctantly sold his land to a businessman and decided to quit farming. On what was once irrigated paddy growing three rice crops a year is a factory making concrete pipes.

The factory that now uses the land Darmono sold employs more people and generates more income than his farm ever did. So this story could be labeled Economic Success.

Instead, Rural Failure may be a more appropriate label—and it's not an isolated event. Which is why Darmono's experience is significant. His story shows what's happening to Indonesian agriculture when planning isn't implemented. Here, he tells it himself:

I was one of eight children. We all worked on the land, as did our parents. Sometimes we owned land and worked it ourselves. Or we worked for other farmers. Although we bought and sold, we always lived in the same area.

We had a vanilla plantation, but thieves made that crop unprofitable. So we grew rice. In good seasons, we could harvest plenty of rice.

When Suharto (Indonesia's second president) started the Green Revolution (in the early 1970s), we had to use fertilizers and pesticides. We had no choice.

When people offered top money for our land to build factories, we'd sell, and use the money to buy elsewhere. But they usually wanted the best level land with good water. So we had to move to poor-quality land.

There are now factories growing mushrooms and intensive chicken farms in our area—even one making industrial alcohol. Their waste goes into the water, which is getting dirtier. The fertilizer from farms higher up the hill gets into our water.

We should be able to make ends meet if we had fertile land, but there are political pressures to sell from within the community. People see the factories providing jobs.

Two years ago, I sold the last of my land for the concrete pipe factory. Even my brother, the village head, pushed me to sell. Now I tend a few goats for fun.

Darmono and his wife, Tamini, 61, now live in a house built with the proceeds of their land sale. They rely on their five children for food, for Indonesia has no social welfare system. The house is just 250 meters down a slope from the pipe factory, where rubble has replaced rice.

Indonesia has regulations affecting the location of factories, but these are seldom followed. Even in suburban areas, noxious industries can be found alongside residential homes.

As with all social change, there's no single cause for the decline in agriculture. Higher wages elsewhere, small-town boredom, and lack of city facilities are factors. So is the belief that farming is a low status job unworthy of modern youth.

The loss of productive land to roads, cities, and golf courses is well known. But the uncontrolled spread of small factories into rural areas, where land is cheap and labor plentiful, is a phenomenon only now being understood as it becomes more common.

Duncan Graham is an Indonesia-based writer specializing in multicultural issues in Indonesia.

the confusion of the new Indonesian democracy is not without precedent and ironically began with an initiative by President Suharto himself. In 1986, as a result of direct discussions with a wide range of Indonesian and international experts, Suharto recognized the role of pesticides in disrupting natural pest control and removed subsidies for, and then banned, most insecticides.

To marry farmers' traditional knowledge of pest control with the useful parts of Green Revolution technology—such as disease-resistant high-yielding varieties, high-quality seeds, and improved soil fertility—the government implemented a large-scale farmer extension program in the form of integrated pest management (IPM) farmer field schools in 1989. This program was led by Peter Kenmore, Kevin Gallagher, and others from FAO. These "schools" involved regular meetings of a group of farmers and would follow a rice crop through a growing season.

The classic way to implement an extension program had been

AN OLD farmer demonstrates an *ani ani*, the small knife used in the past to harvest traditional rice varieties. The short, sturdy stalks of modern varieties require a sickle.

Shadow puppets reflect old ways

by Duncan Graham

Tumpang is an ancient hillside farming village in the center of Indonesia's East Java Province. It squats on the flanks of Mount Semeru, an active volcano puffing light gray ash across the countryside and so fertilizing the land. Temple ruins date back to the 13th century Singosari kingdom.

According to connoisseurs, Tumpang was once home for some of the nation's most delectable rice. The locals go further. They say Tumpang is where rice culture began, and that anthropologists—who source the grain and irrigation techniques from northern Vietnam during the Dongson Period more than 3,000 years ago—are wrong.

"People used to come to Tumpang just to buy the special varieties, even though the price was three times higher than that of normal rice," says Soleh Adi Pramono (*pictured*). He's a local *dalang* (puppet master) in the *wayang kulit* shadow puppet theater. Using two-dimensional figures made from cow hide, one of his regular jobs was to choreograph shows to mark planting and harvesting ceremonies.

"Then, in the early 1970s, the government ordered farmers to start using modern varieties of rice as part of the Green Revolution," recalls Soleh. "The taste wasn't so good, but yields were higher. Instead of two harvests a year at specific periods, growers could produce three crops, planting at any time. More money was available, but the new system shattered the ways of doing things. It hurt the spiritual side of farming. Rice became a commodity—not a culture. People stopped working together."

Soleh Adi Pramono knows much about the old ways. His father, uncle, and grandfather were all performance artists. As a child, he was taken by his grandmother to the ancient ceremonies, the nightlong dances, the mysterious *wayang* shows recounting tales from long ago.

After training as a dancer and *dalang* in Yogyakarta, a major cultural base in Central Java, Soleh returned home to Tumpang determined to maintain the old culture. This he has done with his American wife Karen Elizabeth Sekararum.

Unexpectedly, at least one arm of authority has tentatively tried to turn farmers back to remembering traditional ways. Soleh was commissioned by the local agricultural training center to write and stage a play praising the virtues of the old system.

Such performances have long been part of government social engineering. Under President Suharto's administration, *wayang* was used to propagate messages about the need for family planning.

Soleh said that the *wayang* play he wrote—*The descent of good fortune and material wealth*—didn't go into technical details on how to grow rice or why some techniques failed. It was about caring for the land through recognition of its importance in the cycle of life.

"The play tells the legend of how the planting of rice has always been a spiritual activity," he says. "Of course, it's too late to go back entirely to the old methods because they can no longer support modern society.

"But, I feel the ceremonies, offerings, and *wayang* performances must be maintained. They provide information about uniting the basic issues of rice and farming with the lofty intelligence of the gods, and about keeping them happy. Even though modern methods are used, they must be in tandem with the ancient ceremonies and the *wayang*.

"This is important so that no one forgets the traditional philosophies and the proper way to respect the gods and their ancestors."

a scientist in a classroom telling farmers what to do. Unfortunately, Dr. Kenmore points out, this tended to fail because farmers often mistrusted scientists and disliked being told what to do.

According to Dr. Gallagher, structured learning exercises gave farmers the chance to field-test recommendations and gain in-depth understanding of the ecological processes underlying IPM.

"In the field school project, a dialogue approach between scientists and farmers worked extremely well," he says. "These schools relied on the rice field to define problems and let farmers collaborate with scientists and extension workers to solve their problems without risking their livelihoods."

Jim Davie of Development Alternatives Incorporated, which directs the U.S. Agency for International Development–funded Environmental Services Program in East Java (see *Solving a rural pollution puzzle* on page 36), points out that "the Green Revolution led to rapid and disorganized development of large areas of countryside, so that now it's not even practical to deal with urban and rural pollution separately, as happens in developed countries.

However, this is also a really exciting time because people are enthusiastic about democracy and, with access to the right information, they're quite creative and ultimately successful at finding solutions to their environmental problems."

Rice pioneer passes away

Henry "Hank" Beachell, one of the plant breeding pioneers behind "miracle rice" IR8, which launched the Asian Green Revolution 40 years ago, passed away at his home in Alvin, Texas, on 13 December 2006.

Less than 3 months previously, Dr. Beachell had celebrated his 100th birthday on 21 September. Friends and family gathered in Alvin to celebrate the event.

Tom Reid, the mayor of Dr. Beachell's hometown of Pearland, Texas, led off the celebrations with a proclamation honoring the centenarian's achievements. Other notable attendees and well-wishers included Nobel Laureate and fellow plant breeder Norman Borlaug. U.S. President George W. Bush sent official greetings.

Dr. Beachell played a leading role in the development of IR8 at IRRI in the 1960s. The short, sturdy cultivar was the first high-yielding modern rice variety. At a time of rapidly increasing populations in Asia, IR8—which resisted lodging (falling over) and allowed farmers to harvest more than one crop per year—helped avert widespread famine.

Born and raised on a wheat farm in western Nebraska, Dr. Beachell originally planned to work on wheat. Following university, though, the only position he could find, at the U.S. Department of Agriculture (USDA), dealt with rice. It was a twist of fate that would prove fortunate for rice farmers and consumers across the world.

After 32 years at the USDA, Dr. Beachell came to IRRI, where he started work on IR8. In 1996, he and former IRRI principal plant breeder Gurdev Khush received the World Food Prize, known informally as the "Nobel Prize for Food and Agriculture."

Like the rice varieties he bred, Dr. Beachell led a strong and productive life. He will be missed by all.

For an account of the story behind the breeding of IR8, see *Breeding history* on pages 34-38 of *Rice Today* Vol. 5, No. 4.

Books

Global advances in the ecology and management of golden apple snails (edited by R.C. Joshi and L.S. Sebastian; published by the Philippine Rice Research Institute; 600 pages; developed countries US$102, developing countries $52).

Golden apple snails are one of agriculture's worst invasive alien species. This new publication compiles all available information on this devastating pest and the rice systems and countries it has afflicted. The book fills a vacuum on the ecology and management of golden apple snails at a time when their distribution continues to expand.

Topics covered include snail taxonomy, impacts on aquatic ecosystems and farmers' health, and pesticide misuse. Countries suffering golden apple snail invasions have submitted individual reports. There are also chapters dedicated to the use of golden apple snails as a food and as a natural paddy weeder.

Practical in its scope, the book offers ecological and sustainable ways to deal with golden apple snail invasions. This publication will serve as a manual for field researchers and extension workers, and as a reference textbook for biological science students, industry workers, museums, and libraries.

To purchase, visit www.philrice.gov.ph or contact Chona Suner-Narvadez at csnarvadez@philrice.gov.ph or PhilRice, Maligaya, Muñoz Science City, 3119 Nueva Ecija, Philippines.

The little book on hybrid rice economics (by Robin Andrews; 124 pages; US$16.95).

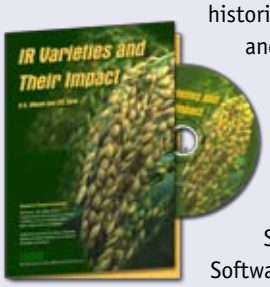
Robin Andrews, former president of RiceTec in the U.S., presents a comprehensive guide to the economic evaluation of hybrid rice varieties. The book presents the economic criteria that determine product viability and insights into why some hybrids fail and others succeed.

With a foreword by Yuan Longping—the "father of hybrid rice"—Andrews's book offers something for plant breeders, agronomists, farmers, seed producers, and administrators involved in hybrid rice development and production. The publication also offers a model for determining a product's potential success.

For purchasing information, go to www.lulu.com/content/448040.

IR varieties and their impact (by G.S. Khush and P.S. Virk; published by IRRI; US$5).

The CD of this popular publication is now available. In addition to pdf files of the book, the CD includes related historic publications and other materials such as Genealogy Management System Search Software. World Food Prize Laureate Gurdev Khush and senior IRRI plant breeder Parminder Virk summarize the available information on 34 IR varieties and list 328 IR breeding lines released as 643 varieties in 75 countries. The CD also contains a listing of 82,354 IRRI crosses made from the early 1960s through 2004.

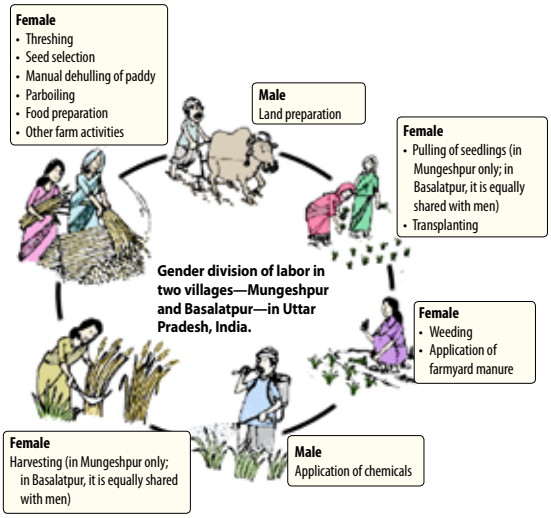


For purchasing information on the book and CD, go to www.irri.org/publications/catalog.

Considering gender

by Thelma Paris

As men's and women's roles change, how should we address gender issues in rice-based agriculture?



Gender division of labor in two villages—Mungeshpur and Basalatpur—in Uttar Pradesh, India.

In many developing countries, women are the primary managers and users of natural resources. Poor rural women play important roles in rice-based farming systems as unpaid family workers, hired laborers, income earners, and major caretakers of family health and nutrition.

In Asia, although farm size, social and economic class, production systems, and cultural norms vary, women's contributions range from 25–80% of the total labor use in rice production. Except for land preparation and spraying chemicals, rice operations are dominated by women.

Women's participation in rice production is highest among lower socioeconomic status farming households in rainfed rice environments (see figure, *above*, for an example). They are also responsible for natural resource management through their day-to-day tasks of providing fuel, water, and food for household consumption and for sale.

Traditionally, the male farmer has been culturally perceived as the head, sole decision maker, and user of technologies. However, this perception no longer holds as males increasingly become part-time farmers. Studies on labor out-migration from major rainfed and irrigated farm households in India, Indonesia, Thailand, and Vietnam revealed that males mostly move away for nonfarm jobs. Consequently, women are taking over responsibilities that were traditionally men's. Women's authority on farm-related decisions among households where men move away for other jobs is found to be higher than among those households without such out-migrants.

Women's roles are beginning to shift from unpaid family workers to *de facto* farm managers as they take on farm-related decisions and managerial roles. Thus, women who are actively engaged in rice farming should be trained in all aspects of rice production so they can make informed decisions. Key knowledge includes what rice varieties to use on specific land types and associated crop management methods.

Generally, the poorer the household and the more fragile the environment, the greater the participation of female family members in rice production and processing. However, compared with men, women have less access to labor-saving technologies, formal credit, alternative sources of income, and information on improved rice production. International Rice Research Institute (IRRI) projects in collaboration with agricultural research and extension systems and nongovernmental organizations in rice-growing countries are now training women in seed health and crop establishment methods as well as enhancing their income-generating opportunities through, for example, growing nonrice cash crops, mushrooms, and multipurpose trees.

IRRI studies have shown that both men and women agree that land type is a major determinant of choice of rice variety. However, there are gender differences in rice variety preferences based on differences in gender roles in rice production and the use of rice as food and by-products. Thus, there is now a move to ensure that women are consulted on variety selection and that women's criteria—particularly for postharvest and cooking and eating quality—are considered in plant breeding objectives.

The issues are not limited to gender alone. Labor-saving technologies, for example, can have different employment consequences for women from farm versus landless households. In Vietnam, the plastic drum seeder reduced the drudgery, work burden, and time requirement of women from farming households, but poor and landless women's wage-labor income declined. Thus, policies and technologies that create alternative income opportunities for poor rural landless women are needed to mitigate the negative consequences of labor-saving technologies.

Despite the crucial roles that women play in sustaining household food security and coping with poverty, gender inequities exist in access to resources, technologies, and opportunities in many agricultural projects and programs. Thus, social analysis—including gender analysis—is important to increase understanding of the gender-based division of labor and gender differences in access to and control of resources and benefits. Reducing gender inequities and tapping women's potential as agents of change are key strategies for reducing poverty, sustaining household food security and nutrition, and protecting the environment.

Dr. Paris is a senior scientist (socioeconomist and gender specialist) in IRRI's Social Sciences Division.

ACHIM DOBERMANN

Food or Fuel?

The International Energy Agency (IEA) estimates that renewable energy sources account for about 13% of the world's total primary energy supply. Nearly 80% of these renewables are in the form of combustible biomass—mostly wood, charcoal, crop residues, or other wastes burned for cooking, heating, and other activities in the developing world.

Now, high oil prices and the need to reduce dependency on fossil fuels (and thus also offset greenhouse gas emissions) are driving rapid commercialization of solid, liquid, and gaseous biofuels. For example, within the next 5 years, most of the maize produced in the U.S. states of Iowa and Nebraska is likely to be used in ethanol production. The overall share of maize used in the U.S. for ethanol is projected to increase from the current 10% to 25% by 2010.

China, the world's third-largest ethanol producer, also emerged as an ethanol exporter in 2006. Pioneer Hi-Bred is investing in developing "ethanol" corn hybrids for the Philippines. Indonesia hopes to see biofuel account for 10% of its fuel consumption by 2010 and has earmarked US$1.4 billion for 2007 to develop 500,000 hectares of land for biofuel production.

Is biofuel production just a short-lived gold rush or is this an industry here to stay?

Is this just a short-lived gold rush driven by high oil prices and large profit margins, or is this an industry here to stay? What implications will this have for world cereal production and how does rice fit into this picture?

A crude calculation illustrates some of the issues we face. At present, average world cereal yield is about 3.1 tons per hectare. If the world cereal harvest area remains unchanged, this average yield needs to increase to 4.3 tons per hectare by 2025 to meet the expected cereal demand of the growing world population. Factor in an extra 5% grain converted into ethanol, and the figure rises to 4.5 tons per hectare. This represents a 45% increase over current yields and, unless nitrogen fertilizer use becomes more efficient, it would come at the cost of a 65% increase in nitrogen consumption on cereal land. If the decline in world cereal area observed in the past 20 years (a reduction of 0.3% per year) continues, the situation becomes much worse, requiring an average cereal yield of nearly 4.9 tons per hectare by 2025.

Keeping the rice price low for the urban and rural landless poor in Asia has been a primary achievement of the higher yields that came out of the Asian Green Revolution, and it remains a key development target. World rice prices have already doubled in the past 5 years (48% in the past year alone) and are projected to rise further. Although most rice consumers in Asia, where most rice is locally consumed, are shielded from the world market price, the emerging biofuels industry will probably add to price pressure on cereals, including rice. Rice grain is not likely to be diverted into ethanol production in significant amounts but some rice may be diverted to produce starch (for industrial use) to make up for deficits arising from the conversion of other crops to ethanol.

Another potential threat is that rice farmers may opt out of rice and diversify toward more profitable cropping systems, including potential biofuel crops such as maize, sugarcane, or cassava. So, maintaining low rice prices *and* lifting the income potential of rice farmers seem contradictory goals in a world of rising input costs in agriculture.

Renewable energy options must satisfy three conditions: resource availability, technical maturity, and a policy and economic environment that supports commercialization. The nearly 600 million tons of rice straw produced each year worldwide represent such an exploitable biofuel resource. However, many of the technologies that allow rice straw to be converted to ethanol are still at an early stage of development. It remains to be seen whether they can be scaled down to village-level, on-site bioenergy production and how much straw can be removed from rice land without threatening soil fertility and the overall productivity of the system. There is also much potential for developing technologies for producing a variety of rice-based products, including ethanol, fibers, and biochar (used for soil improvement).

Growing food crops to also provide fuel for our cars or homes is something many agricultural researchers will need to get used to. Now is the time to address this and develop suitable technologies for integrated food and bioenergy production systems in Asia that are energy-efficient and sustainable, provide new employment opportunities for the rural population, and also offer new sources of income for rice farmers.

Dr. Dobermann is a professor of soil science and nutrient management at the University of Nebraska, USA.

Raising productivity for rainfed rice ecosystems

Rainfed rice ecosystems are diverse and geographically dispersed across monsoon Asia. Farmers here face low, unstable yields and high rates of poverty. Research that delivers appropriate technologies must involve partnerships across international research centers, advanced research institutions in developing countries, national agricultural research and extension systems (NARES), and farmers' organizations.

The Consortium for Unfavorable Rice Environments (CURE) provides a platform for research and technology validation at key geographically diverse sites in Bangladesh, Cambodia, India, Indonesia, Laos, Myanmar, Nepal, Philippines, Thailand, and Vietnam. The consortium is guided by a steering committee composed of research leaders of NARES and coordinated by the International Rice Research Institute (IRRI).

Through interdisciplinary research, CURE partners with men and women farmers to help them improve their living standards. CURE develops technologies that make a positive difference in rice productivity and rural livelihoods.

Recent support from the Asian Development Bank's Regional Expertise Technical Assistance program has helped CURE to build the research capacity of its partners in host countries.

CURE's research covers

- Drought-prone lowlands
- Submergence-prone lowlands
- Salt-affected lowlands
- Shifting upland systems
- Drought-prone plateau uplands
- Intensive upland systems with long growing seasons

CURE is guided by a commitment to

- Multidisciplinary research teams
- A participatory approach to research
- Scientific excellence
- Partnership with organizations that share common goals
- Gender consciousness
- Cross-cultural communication
- Learning from indigenous knowledge
- Environmental protection

For more information, contact

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