Lao-IRRI Project

Rice: The Fabric of Life in Laos

Writer/Editor
Joyce Gorsuch

IRRI

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2002
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The responsibility for this publication rests with the International Rice Research Institute.

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Suggested citation:
Gorsuch J. 2002. Rice: the fabric of life in Laos. Los Baños (Philippines): International Rice Research Institute. 41 p.

Writer/editor: Joyce Gorsuch
Cover design: Juan Lazaro IV
Cover images: Seepana Appa Rao, Joyce Gorsuch
Page makeup and composition: George Reyes
Special thanks: Paul Belder, Mark Bell, Albert Borrero, Bounmy, Renate Braun, Peter Fredenburg, Karl Göppert, Gene Hettel, Werner Hunziker, Michael Jackson, Gary Jahn, Khamouane Khampoukeo, Bruce Linquist, Duncan Macintosh, Millet Magsino, Paul Marcotte, Phoudalay Lathvilavong, Seepana Appa Rao, Edna Reyes, Tess Rola, John Schiller, Sulasith, and the Lao farmers and national staff who gave their time and effort to inform me about their collaborations with the Lao-IRRI Project.

About the cover:
Lao landscape (background), farmers in rice field, and locally made fabric.

ISBN 971-22-0178-3

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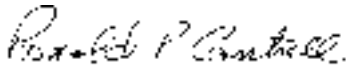
FOREWORD

For small poor nations such as Lao PDR, few things are more important to future development than the skills, knowledge, and abilities of their citizens. For this reason, the International Rice Research Institute (IRRI) is proud to have been actively working with the Lao national agricultural research and extension system to help enhance the nation's capacity for vitally important agricultural research. The Lao-IRRI Rice Research and Training Project (LIRRTP) and the Biodiversity Project (Safeguarding and Preservation of the Biodiversity of the Rice Gene Pool) have allowed collaborators to learn from each other through the production of research literature and through direct linkages between organizations and individuals.

Documentation of this partnership allows other researchers to benefit by learning about these endeavors and their farm-level impact. The projects have contributed to enhanced capacity building within Laos and a deepening of relationships among national scientists, extension agents, and their research partners. Also, the Lao people have achieved an impressive increase in rice yield because of the use of advanced irrigation techniques and improved rice varieties. According to the United Nations Food and Agriculture Organization, overall annual rice production increased from 1.5 million to 2.2 million metric tons from 1990 to 2000.

In addition to higher rice yields, Laos has come closer to achieving its long-term environmentally conscious goal of completely phasing out the practice of slash-and-burn shifting cultivation for all crops by 2005. The Lao government seeks to achieve this goal by developing more sustainable technologies for the uplands, improving the access of farmers to markets by improving the road infrastructure throughout Laos, and tapping into a wealth of indigenous knowledge that is the source of creative and appropriate ideas for meeting this challenge.

I would like to congratulate our Lao colleagues for their achievements. May the stories in this document inspire their continued efforts to improve the quality of life for Lao farmers.



RONALD P. CANTRELL
Director General
International Rice Research Institute (IRRI)

FOREWORD

An annual population growth rate of about 2.5%—among the highest in Southeast Asia— created an urgent need for food security in Laos.

In response to this need the Lao Government has formed a productive, enduring, and three-way partnership with the Swiss Agency for Development and Cooperation (SDC) and the International Rice Research Institute (IRRI).

Within this partnership two significant projects began in the 1990s. The Lao-IRRI Research and Training Project (LIRRTP) was initiated in 1990. It had the longer-term objective of making the country self-sufficient in rice. A second project, "Safeguarding and Preservation of the Biodiversity of the Rice Gene Pool," commenced in 1995 with the objective of conserving the irreplaceable traditional rice germplasm within the country through a program of collection and storage of the germplasm base.

Both projects have developed the national rice research capacity of Laos through a combination of research program development and training. These operations were supported by substantial investments in support facilities including research- and training-related infrastructure—facilities within a network of research centers, equipment, and vehicles.

The net result of SDC's support for the above projects has been the development of a national rice research program that is addressing the needs of all rice-producing environments of the country; development and farmer adoption of improved rice production technologies for the lowland environments; and long-term conservation and immediate utilization of the traditional rice germplasm base. These technologies have enabled the country to become self sufficient in rice.

The Lao Ministry of Agriculture and Forestry and the people of Laos look forward to further collaboration with IRRI and far-sighted donors such as the Government of Switzerland.

DR. SIENE SAPHANGTHONG
Minister of Agriculture and Forestry
Lao PDR

J. Gorsuch

Farmers transplant rice seedlings in their field, which is next to Phone Ngam station in Champasack province.

The challenge

establish a reliable supply of rice in Laos

Rice: the most important crop

Just as brightly-patterned, locally-woven cloth drapes itself gracefully on a Lao person, so do rice crops cloak the land used for growing rice—more than 80% of cropland—in the Lao People's Democratic Republic (Lao PDR).

At a rapid population growth rate of about 2.5% per year, the people of Laos have a tremendous appetite for rice. On average each Lao person eats about 160 kilograms of this staple food per year—about 67% of his or her calorie intake. In fact, rice is the single most important crop in this region, where people have grown and eaten rice for thousands of years.

In the quest to produce more of this important staple the country has reached some milestones. "In 2001 Laos produced 300,000 tons more rice than in the previous year. Laos achieved self-sufficiency in rice production in that same year," says Mr. Karl Goeppert, International Rice Research Institute (IRRI) representative to Laos and team leader of the Lao-IRRI Project.

The achievement of self-sufficiency is significant: according to data from the Food and Agriculture Organization (FAO) of the United Nations, Laos has had a rice import rate of 0% in only four other years since 1961, when FAO started keeping track of the rice trade between Laos and other countries. In other years the country has imported on average 20,000-60,000 tons per year, and up to as many as 130,000 tons per year.

J. Gorsuch

The banks of the Ou River (right and below) are sites of trade and travel for local rice farmers. Rivers are part of daily life for many Lao people. They also are a source of water for irrigation. It may surprise readers, then, to learn that in the Lao language, Laos is not named for its rivers but rather is referred to as *Lane Xang*, "the land of a million elephants."

J. Gorsuch

Location and economics

As is the case for many other rice-growing countries, Laos' geographic location is in the path of monsoon rains. These rains fall on the country between May and October, keeping the rice paddies flooded for half of the year. A small landlocked country, Laos shares a border with five other rice-growing countries: Cambodia, the People's Republic of China, Myanmar (Burma), Thailand, and Vietnam.

Geographical and historical circumstances make Laos rich in tradition but poor in the economic sense:

- At 5.1 million people the population of Laos is smaller than that of its neighbors, but it has one of the highest population growth rates in Asia—2.5% per year.
- Adult literacy is 60% and life expectancy is 51.7 years.
- Average family size is 6.7 members.
- From 1994 to 2000, GDP per person was less than US$386 per year.
- In 1998 the United Nations Development Program (UNDP) human development index ranked Laos as the second poorest country in Southeast Asia.
- Nearly 85% of the population engages in subsistence agriculture.

Agriculture: the most important economic sector

Agriculture dwarfs all other sectors of the Lao economy, generating 57% of the country's GDP. (The service sector contributes 26% and the industrial sector contributes 17%.) Laos has about 5 million

G. Trebuil

A familiar sight for Lao farmers: the sun goes up over a rice field.

hectares of land that is suitable for cultivation. Of that land, farmers plant only 800,000 hectares with rice or secondary food crops. They use another 750,000 hectares as pasture land and 50,000 hectares of ponds for freshwater fish farming. (The fishery sector provides an important source of protein.)

Land, then, is one resource that farmers already have for pursuing their agricultural activities; various government bodies allocate this land to individuals. (Since the 1990s, the Lao government has released to farmers much of the agricultural land that it used to own.)

Agricultural production is the sole source of food and income for about 95% of rural households. Average farm size is between one and two hectares of fields in the low-lying areas, plus plots in the uplands (areas with a slope of 12% or more).

Laos also leads the rest of Southeast Asia in the production and consumption of glutinous (sticky) rice. Traditional rice farming practices in Laos have relied on rain for the water that floods the rice paddies. To have a farming cycle that makes the most efficient use of the rainfall pattern, farmers here usually grow varieties of glutinous rice that are photoperiod-sensitive (sensitive to amount of daylight). These varieties mature in October, after the wet season ends, and so sunlight is most available when the plant has the greatest need for it.

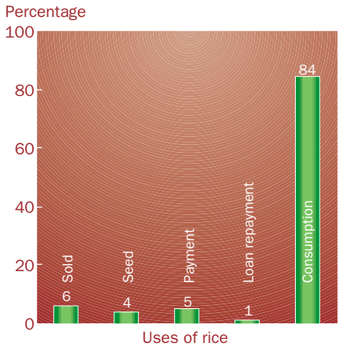
Lao IRRI Rice Research and Training Project (LIRRTP): long-term support, unity of purpose, and US$13.82 million

International development programs began going into Laos after the institutional framework in that country fell apart and a large number of educated people departed. The primary objective of these programs, then, has been the development of institutional capacity. Within this overall activity, the quest for long-term sustainability in rice production is a direct reflection of the steady role that the Swiss government has played as a major donor in Laos.

In 1990 the Lao government, the Swiss Agency for Development and Cooperation (SDC), and IRRI started the Lao IRRI Rice Research and Training Project (LIRRTP). In collaboration with personnel from the national agricultural research and extension service (NARES) the SDC-funded, IRRI-administered project has worked to boost food security, preserve natural resources, and enhance institutional development and training within Laos. By training national scientists, the Lao-IRRI Project has built capacity, facilitated the development of technology for rice farming in Laos, and supported the efforts of the Lao government to make the country self-sufficient in rice.

For more than a decade rice farmers, extension agents, and researchers in Laos have worked with researchers at IRRI to accomplish three major goals:

- Increase the yield of rice in Laos
- Cultivate and train a pool of farmers, extension workers, and researchers in Laos
- Conserve irreplaceable biodiversity by collecting, storing, distributing, and growing out rice grains from Laos

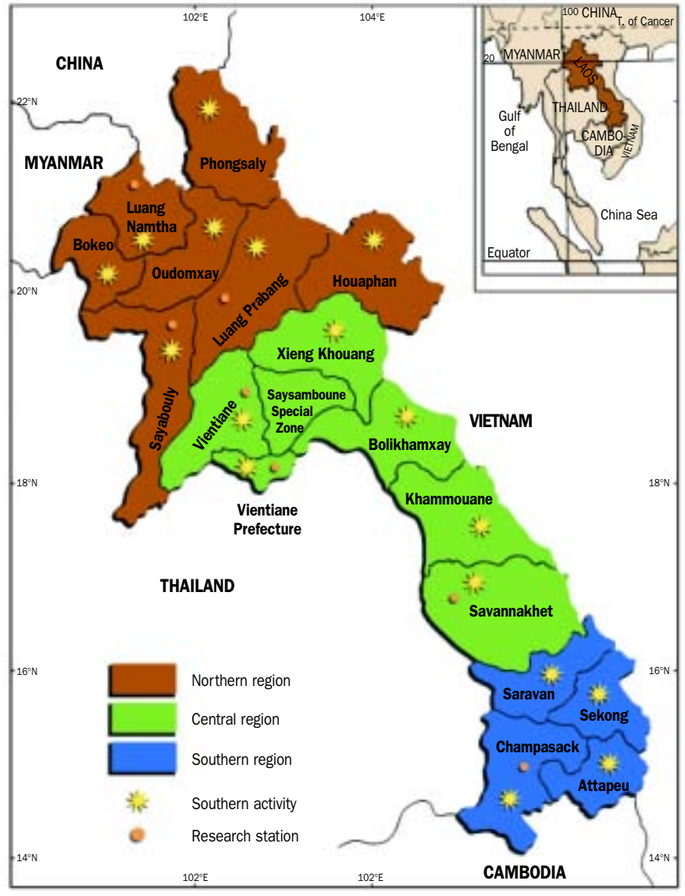


Nearly 85% of the population engages in subsistence rice farming in Laos.
Source: Lao-IRRI Project.

Lao agricultural research system

"Ultimately the basis for success [for international development programs] is not external funding or expertise, but the political will of the countries to make the programs work," comments Dr. John Schiller, former team leader and research programmer of LIRRTP. Laos has had this political will; in fact, the Lao-IRRI Project is a strong example of institutional development and cooperation. The successful building of a NARES has given Laos a vital tool for feeding its people.

Conservation and rice research are major components of this tool. National scientists at the principal research center, the National Agricultural Research Center (NARC) in Vientiane Municipality, oversee the country's germplasm bank. They also conduct research, 80% of it under on-farm conditions. Crossing and evaluation of varieties for rainfed low-lying areas is a particular focus of NARC. In addition to the activities at NARC, regional research centers throughout Laos conduct varietal improvement efforts that include replicated yield trials, multilocation trials, and collaborations with a crossing program at



National scientists from seven research stations assess new varieties; new practices; regional growing conditions; and specific issues such as germplasm collection and storage, rodent management, rice bug infestation, and depletion of soil nutrients.
Source: 1998 Annual Technical Report, National Rice Research Program and Lao-IRRI Project.

J. Schiller

A local woman and her family prepare a meal. In Laos, people frequently describe the eating of food as *kin khao*, which translates literally as "to eat rice."

the Ubon Rice Research Center in north-eastern Thailand.

Capacity building: cultivation of national professionals

National scientists who staff these research stations have contributed invaluable indigenous knowledge of Laos. Training programs have paired this hands-on knowledge with the latest discoveries in rice research, to develop a core of knowledgeable extension agents and researchers and, through them, to enhance the NARES in Laos.

Minister of Agriculture Dr. Siene Saphangthong, an IRRI alumnus (research fellow) and a former member of the IRRI Board of Trustees, has been a vital supporter of these training programs, many of which have been available through the Lao-IRRI Project. "Lao-IRRI has been more fortunate than other projects in Laos because of political support from Dr. Siene," recalls Dr. Schiller. That support facilitated IRRI's entry into Laos. "Dr. Siene has been accessible during the entire project. He has called in to find out how things are going and to keep himself informed. This flow of information has been critical."

Along with key support from the Lao government, farmer participation has been another asset; it is the best assurance that research efforts will address the needs of farmers. The Lao-IRRI Project increasingly relies on the practical expertise of local farmers to test improved varieties and recommended farming techniques. Personal links between farmers, extension agents, national scientists, and the farming communities from which they come promise to facilitate the contributions that Lao nationals make to the NARES.

Major achievements of LIRRTP

Major achievements of the Lao-IRRI Project include the following:

- Savings (through increased rice production) of about US$100 million—eight times the budget of the entire project through 2003.
- Establishment of a nationwide infrastructure of rice research stations.
- Training of about 120 researchers, 80% of whom work full-time in rice research and production.
- Release of seven new rice varieties, which are now grown on 70% of low-lying rice area. More releases are to follow in 2003.
- Collection of about 13,600 samples of indigenous rice varieties as part of a sub-project of the SDC-funded Biodiversity Project. Samples represent about 3,000 rice varieties.
- Establishment of a national germplasm bank.
- Accomplishment of seven masters degrees to date, plus provision of more than 220 places for short-term training abroad. Staff members are pursuing additional masters degrees.

In addition to these achievements, the success story of the Lao-IRRI Project is made up of personal stories. Woven together, these stories form a fabric of successful capacity building for this small country.

J. Schiller

Farmer life

Ban Lak Sip village—a snapshot of the challenges faced by Lao farmers

Effective rice research begins and ends with the people it is meant to help—namely, farmers.

In Laos, family and community, not individuals, are the basic units of activity. Extension agents and scientists therefore approach rice farming as a community venture. In the Oudomxay district of Luang Prabang province, farmers in Ban Lak Sip village recently discussed with extension agents and scientists the daily challenges of providing health care for their livestock and their families, resources to send their children to school, and enough rice to feed their rapidly growing families. National extension agents and scientists, participants in the Integrated Upland Agricultural Research Project (IUARP), and staff from the Lao-IRRI Project joined the discussion.

Participatory problem diagnosis

In order to analyze information systematically, participants use a framework called *participatory problem diagnosis*: a process by which farmers, extension agents, and researchers identify the main constraints to well-being within a village. This information can be used to promote the national government's strategic vision for the agricultural sector (1999):

- Stabilization and reduction of shifting cultivation (slash-and-burn)
- Land allocation
- Decentralized, area-focused government services

The information also identifies areas of research. "We want to study issues that the farmers think are important," says Dr. Bruce Linquist, upland agronomist with the Lao-IRRI Project.

Importance of rice

"Since Lao communities are based on subsistence agriculture, identification of important crops is a fundamental step in participatory problem diagnosis," says Dr.

(above and below) Throughout Laos, villagers, extension agents, and scientists discuss day-to-day challenges of rice farming. All parties seek a solution that combines farmers' experience and researchers' technical knowledge.

J. Gorsuch

B. Linquist

A Lao woman places seeds next to the word for that crop, to signify the crop's importance to her and her family. This information will help with land allocation so that villagers can maximize next year's yields.

Struggles of individual Lao families make up the bigger national trends. Concerning the social and environmental indicators below, Laos is striving for a level of well-being that will at least match that of neighboring countries. Rice production, part of the fabric of daily life, is one key to resolving the considerable difficulties that the Lao people face.

Social and Environmental Indicators, Selected Countries

Indicator	Year	Cambodia	Lao PDR	People's Republic of China	Thailand	Vietnam
Human development index rank	1992	153.0	138.0	111.0	58.0	120.0
Population growth (%)[a]	1995	2.7	2.4	1.0	1.2	2.1
Total fertility rate (lifetime births)	1992	5.3	6.8[b]	2.0	2.1	3.9
Life expectancy at birth (years)	1992	51.6	51 .0	68.5	69.0	65.2
Female life exp. at birth (years)	1992	52.9	52.5	70.4	71.8	67.3
Maternal mortality rate (per 100,000 live births)	1980-92	500.0	656.0[b]	95.0	50.0	12.0
Infant mortality rate (per 1,000)	1992	116.0	125.0[b]	44.0	37.0	42.0
Under-five mortality rate (per 1,900 live births)	1993	181 .0	182.0[b]	43.0	33.0	48.0

[a]For the Lao PDR, average annual growth rate for the period 1985-95 (1975-95 Basic Statistics of Lao PDR); for Thailand, growth rate for the period 1994-95 (Population Projections 1990-2020); for the other countries, average annual growth rate for the period 1992-2000.
[b]Lao Social Indicator Survey, 1993.
Source: Human Development Report 1995, except where noted.

Linquist. In this exercise, farmers place a number of seeds next to the word for a particular crop. The more seeds, the greater that crop's importance. This year the three most important crops in Ban Lak Sip are rice (129 seeds), maize (eight seeds), and cassava (five seeds).

Resource mapping

Next, a physical image of the rice farming landscape takes form during a resource-mapping exercise. Villagers map out an area that would take three hours to walk across. The extremely diverse topography of this area contains rice fields, mountains, streams, and forests. Villagers can use this map to identify areas into which they can expand the acreage for their most important crops.

Wealth ranking

Are villagers producing enough of their most important crops? Each of the 43 families in the village ranks itself as most wealthy, moderately wealthy, or poor. This exercise serves to measure the general well-being of the village's inhabitants. According to the criterion of access to rice, about half of the families are poor.

These farmers struggle with rice shortages during part of the year. Their primary constraints to yield are poor soil in the sloping areas, infestation with rats at critical times in the cropping cycle, too many weeds, and livestock mortality due to disease.

J. Gorsuch

Identification of problems

For the poorest families in particular, what are the biggest limitations for rice yield? Identification and ranking of the most severe problems suggest that national staff should prioritize activities in the village to address the following issues:

- Rice farming difficulties in areas with a slope greater than 12% (uplands)
- Rice farming difficulties in flat areas (lowlands)
- Livestock illness and mortality
- Lack of social services

Seasonal calendar

Many villagers' most severe problems occur during a particular time of year. "Timing of problems and of agricultural activities in general takes into account the annual patterns of rainfall, temperature, and migration of animals that form part of the rice ecosystem," explains Somphet, a national scientist from Houay Khot research station. The most difficult months are seven through nine, during which villagers must struggle with rice shortages, livestock diseases, and a greatly increased workload. (Women clear and weed fields, and men burn fields in preparation for growing the next rice crop).

J. Gorsuch

This seasonal calendar indicates that villagers in Ban Lak Sip have the most work and the greatest number of challenges during months seven, eight, and nine of their cropping cycle.

National researcher Somphet (in doorway) and an extension agent (in doorway, wearing hat) facilitate a discussion of the problems that poor farmers face.

National government policy and village planning

Prior to the participatory problem diagnosis, villagers in Ban Lak Sip had begun adapting their practices to accommodate the priorities of the national government. National government policies seek to eliminate slash-and-burn farming and to move villages closer to Laos' new network of roads. In response to these policies, villagers have been expanding lowland farming areas: rice farmers in the village now have three new lowland fields.

These new fields offer two benefits to villagers. In addition to a proportional reduction of upland farming and the erosion that it can cause, increased emphasis on lowland farming promises a significant boost in productivity. On average, reported rice yields for wet-season lowland crops range from 2.8 to 3.4 tons per hectare, much higher than upland crop yields of 1.5 to 1.7 tons per hectare. Reported yields in irrigated areas are even higher: up to 4.3 tons per hectare.

Many physical and social forces act on the phenomenon of rice farming to make it seem at times like a delicate thread that must constantly be protected with the assistance of the latest technical knowledge. At the same time, continuity and resiliency of villagers and their indigenous knowledge give this fiber of tradition the strength it needs as an important thread in the fabric of daily village life. The discussions that are taking place now promise to enhance further the very structure of daily life for millions of Lao farmers and their families.

J. Gorsuch

Wealth ranking in Ban Lak Sip is based on availability of rice

Most wealthy

Khum kin, a local term, means "enough to eat." It describes the village's ten wealthiest farmers and their families, who share the following characteristics:

- Some grow crops in areas with a slope greater than 12% (uplands)
- Most grow crops in low-lying areas
- Most raise livestock
- Most own currency
- Most grow more rice than they consume, so they can sell rice

Farmer interview: Tao Say

Tao Say grows rice varieties that are glutinous, late-matu-ring, tall, and good for eating. However, lodging (leaning over of a plant) can cause the loss of some of the harvest. In previous years he grew a variety that many Lao farmers grow today, but stopped because he and his family did not like it. "I was growing the improved variety TDK1, but stopped because it has a small grain. We like a large grain," he explains through a translator. "Ten kg of large-grain rice can feed us for more days than can 10 kg of small grain." Farmers would like to expand the low-lying areas, but water levels there are too low. A current alternative, upland farming, is much more labor-intensive.

J. Gorsuch

Farmers spend income from selling rice on clothes, medicine, and school supplies for their children. Most farmers in Ban Lak Sip hope that their children will eventually take up an occupation that is less physically gruelling than rice farming. Yet several children have chosen their parents' profession. For instance, "after finishing primary school the eldest child of the village head chose to become a farmer," says Tao Say. Tao Say's own eldest child wants to become a police officer.

Moderately wealthy

Moderately wealthy farmers in the village usually have enough rice to eat. In some years, however, they do not. Thirteen families share the following characteristics:

- Grow crops in uplands; upland farming requires more labor than farming in low-lying areas
- Grow crops in low-lying areas
- Most raise livestock
- Most have enough rice for much of the year, but too little to sell

Farmer interview: Seng On

During the difficult months (seven through nine) Seng On and her neighbors Joy, Khada, Tao Lung, and Kham Tan have the rice bank to fall back on if things get really bad. "For the past three years we have been able to borrow from this store of rice at an interest rate of 10%," Seng On explains through a translator. A villager who borrows 10 kg of rice repays the bank with 11 kg of rice. (Rice is the only form of repayment.)

J. Gorsuch

Like many moderately wealthy farmers in Ban Lak Sip, Seng On is relatively fortunate because she has a lowland field, which is more productive than her upland field. "Poorer farmers usually have only upland fields," she says. Lao farmers are leery of sharing information about their acreage with new acquaintances, but Seng On is willing to say that she uses 30 kg of seed to plant her crop.

Seng On supplements her rice farming income by growing other crops (sesame, chilies, eggplant, melon, and yam) side-by-side with rice, and by collecting materials (mulberry bark used for making paper and a feathery green plant used for making brooms) from the forest.

Poor

Every year farmers in this group have too little rice and must do other work, in addition to farming, in order to buy enough rice. In Ban Lak Sip, 20 families share the following characteristics:

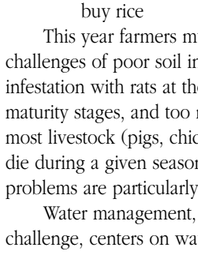
- Less land than more prosperous farmers
- Poor soil
- No crops in low-lying areas
- Many children
- Much livestock illness, mortality
- Gather and sell forest products in order to buy enough rice to eat
- Sell their labor to the nearby Hmong community in order to buy rice

This year farmers must endure the challenges of poor soil in upland fields, infestation with rats at the flowering and maturity stages, and too many weeds. Also most livestock (pigs, chickens, and ducks) die during a given season. This year the problems are particularly bad.

Water management, an additional challenge, centers on water sources and entails a lot of physical labor. Drinking water comes from a mountain stream and farmers boil it before drinking. Water for growing rice is delivered via canals (low-lying areas) or in containers that farmers carry on their shoulders (uplands).

Farmer interview: Bun Le

A self-described "newcomer," Bun Le came to Ban Lak Sip from Phongsaly province—14 years ago. Because his family suffers a shortage of rice for three months out of every year, he and his family have experimented with growing nonglutinous rice. "Most Lao farmers prefer to grow and eat glutinous rice only," he explains through a trans-lator, "so by growing nonglu-tinous rice I was doing something that was very new." By the end of the most recent crop-ping season Bun Le had grown 50 kg of nonglutinous rice, and 60 kg of glutinous rice. Although Lao people prefer the eating qualities of glutinous rice, Bun Le sees advantages to growing nonglutinous rice: "For every kilogram of nonglutinous rice I need three kg of glutinous rice to feed my family of 10."



J. Gorsuch

Although Bun Le and his family appreciate the eating qualities of nonglu-tinous rice, they have been unhappy with the low yield of nonglutinous rice in their third year of growing it. Bun Le's response to this setback highlights an important aspect of working with farmers: the need to understand how long-held beliefs shape local farming practices. "Farmers believe that some people simply are unable to grow certain varieties," he explains. "They don't see success as depending on soil, climate, or other environmental conditions." So Bun Le has gone back to growing two local glutinous varieties only: Hom and Deng.

Like their more prosperous neighbors, poor farmers borrow from the rice bank during rice shortage months. However, the rice bank is only part of the solution to rice shortages; sometimes the bank runs out of rice. Families that have the first shortages after harvest get the rice. Families that have shortages later on implement an alternative strategy; selling their labor to the nearby Hmong community. (The Hmong is an ethnic group that lives in the area, eats nonglutinous rice, lives at a high elevation [800-1,000 meters], farms areas that have good soil, and sells bamboo shoots to earn income.)

J. Gorsuch

Water management, a major issue, centers on water sources and entails much physical labor. Water for growing rice is delivered via irrigation canals (as shown in photo) or in containers on the shoulders of farmers.

Alternatives to slash-and-burn

As part of the Lao government's strategy to reduce the amount of land devoted to slash-and-burn upland cultivation of rice, farmers brainstorm with national extension agents and researchers to explore options for replacing the income and food that have come from this type of farming. Several activities offer an alternative: the gathering, cutting, and selling of wood; the growing, collection, and selling of bamboo shoots along the roadside; and the growing and selling of eggplants and chilies. Of these enterprises the growing and selling of bamboo shoots offers the most promise for increasing the income of farmers. One bundle of 12 shoots feeds five people and sells for 1,000 kip.

An income of several thousand kip greatly increases a farmer's purchasing power. "The price for milled rice is 1,500 to 2,000 kip per kg," says Bun Le. Widely available glutinous rice sells for 2,000 kip per kg and less common nonglutinous rice sells for about 2,700 kip per kg.

Additional income: local Hmong people sell bamboo shoots along the road between Ban Lak Sip and the town of Oudomxay in Luang Prabang province.

J. Gorsuch

Village children balance classes, subsistence farming

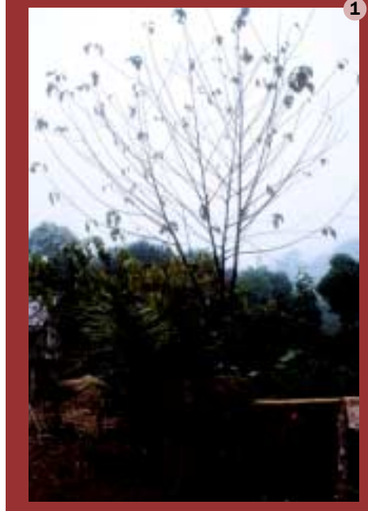
Additional income from the selling of bamboo shoots and other items helps family members to finance their dream of a better life for the next generation. Education is a key part of this dream. "Our village's school lacks teachers for all class levels, so families pay to send their children to another village after the first two primary classes," says Bun Le. Ban Lak Sip's children balance academics and subsistence farming. "Children stay overnight in the villages where they study, and come home on the weekends to help out on the farm," he explains.

"We want our children to complete their studies and work in town either for the Lao government, or in a specialized field such as teaching," says Bun Le. Very soon the village will benefit directly from the realization of such dreams. "Two children from Ban Lak Sip recently became teachers. Next year they will return to the village and open a school that offers every level of primary class," he says proudly.

Ban Lak Sip has no electricity. But villagers have an abundance of energy—namely, the motivation to improve their lives. By helping farmers to help themselves, projects such as Lao-IRRI can assist in tapping this potential.

Production of roofing material from palm leaves.
All photos by J. Gorsuch.






Production of paper using mulberry bark.
All photos by J. Gorsuch.


Personal stories

improved practices

Mapping out a mystery: Linquist unearths information about Lao soils

Beneath our feet is a living mystery: the alchemy that takes place when seeds, sunlight, water, and soil nutrients combine to create life.

In Laos, Dr. Bruce Linquist—former lowland agronomist and current upland agronomist with the Lao-IRRI Project—and his colleagues are working to map out the particulars of this magic. Prior to the work of this team, little had been done to record the great variety of soils in this culturally, biologically, and topographically diverse country.

Much of the progress in documenting soil types in Laos is due to the contributions of talented national scientists, and to successful institutional capacity building that enables the project to work with these highly capable scientists. "In 1990 the SDC-funded Lao-IRRI Project opened an office in Vientiane (the capital of Laos) that operated with three staff members. Over the past decade, the number of staff members has grown to 100," says Dr. Linquist. "One clear success of the Lao-IRRI Project is the National Rice Research Program, which works with national staff members and which is responsible for developing an institution for rice research."

Within this institutional framework, scientists from various disciplines have studied many aspects of the soils in Laos: soil nutrient limitations that are found in particular areas in the lowlands, timing and rate of nutrient application that is most effective for a particular soil, and effectiveness of organic versus inorganic fertilizer. These studies have also evaluated the effectiveness of green manures—legume crops such as cowpea (*sesbania rostrata*)—which are grown on the rice field in between rice crops, then cut up and mixed into the soil to replace the nitrogen that the soil loses during the rice-growing season.

Based on these studies, the team has recommended improved practices for nutrient management in the lowlands; improved varieties that could be grown to increase local yields by over 100%; and training that would facilitate the exchange and use of information among farmers, extension agents, and researchers.

Given the complex nature of soil chemistry and its interaction with the environment, Dr. Linquist and collaborating scientists have many clues to investigate in the years ahead. These activities promise to reveal more about the role that soil plays in the lives of Lao farmers, and to strengthen the ties that facilitate the sharing of physical resources, skills, and knowledge.

Dr. Bruce Linquist (stooping and inset), national scientists, extension agents, and local villagers assess the needs of a village in northern Laos.

J. Gorsuch

Seeing rice research through local eyes: Chay Bounphanousay guards priceless genetic resources

A number of agricultural research facilities have been successfully established in Laos. So have several national scientists.

Ms. Chay Bounphanousay, head of the administration unit at the National Agricultural Research Center (NARC) near Vientiane, is originally from southern Laos. She became interested in agriculture because she saw it as a powerful tool. "Agriculture is the basis of food production, and the population of Laos is growing at a high rate—about 2.5% per year—so we must produce enough food to meet that need," she explains.

Ms. Chay also had a mentor who encouraged her interest in agriculture. "My supervisor encouraged me to earn my masters degree and participate in training courses." Ms. Chay studied in Russia to earn her bachelors and masters degrees in biology. She also has participated in Genetic Evaluation and Utilization (GEU) training courses at IRRI, which have taught her about rice improvement and germplasm evaluation. Additionally, at IRRI and in India she has learned about the management of seed genebanks.

Since 1990, Ms. Chay has worked with varieties of rice that are found growing in Laos and nowhere else. One of only a few national scientists who were available to work in Laos in the early 1990s, her contributions have made it possible for several research activities to take place. "From 1990 to 1995 I was involved in rice improvement," she explains. "I selected plants from those lines that had promising characteristics, grew the seed from those lines in an observation nursery, and then bred those plants."

From 1995 to 2000 Ms. Chay carried out key activities for the SDC-funded biodiversity project. Her lifelong familiarity with Laos and its flora was clearly an asset in performing this work. "I collected plant material and seeds throughout Laos, including material from varieties that my family grows and eats. Then I grew out a set of seeds in order to produce many more," she explains. She also was involved in an in-country training course on collection and conservation of rice biodiversity.

From 1995 to 2000, Ms. Chay (left), Dr. Seepana Appa Rao, and the rest of the collection team gathered seed and other materials from rice plants. Dr. Rao trained the collection team.

G. Hettel

Conservation of traditional varieties will be very useful for varietal improvement. "These materials are already in the improvement program," says Ms. Chay. For example, the traditional varieties Khao Kondam (from Kasi District in Vientiane Province) and Khao Vieng (from Xieng Ngeun District of Luang Prabang Province) were selected for on-farm testing in other parts of the country in 1999. "More collected materials will soon be appearing in improved Lao varieties," she adds. "In 1998 we gave 160 samples of nonglutinous rice to the NARC Rice Improvement Unit for observation and study, some of which were subsequently added to the crossing block."

In conclusion, the benefits of the project to the NARES go beyond conservation of rice genetic resources. "This effort has invigorated their conservation programs, provided knowledge and skills that can be used on other crops, and made governments more aware of the threat that genetic erosion poses to plant genetic resources," says Dr. Mike Jackson, former head of IRRI's Genetic Resources Center and current director for research program planning and coordination at IRRI. Additionally, the training of extension workers and research staff has been an effective strategy in collecting and preserving crop germplasm. It has enhanced skills and broadened the perspective of national staff regarding the conservation of plant genetic resources.

This experience has prepared Ms. Chay for her current work. Since 2000 she has headed the administration unit at the National Agricultural Research Center (NARC) in Vientiane. Familiarity with germplasm conservation activities has given her a big-picture perspective that is vital for managing day-to-day activities at the center, coordinating with other organizations (the South East Asia Regional Initiatives for Community Empowerment (SEARICE) and the Department of Agriculture (DOA) of Laos, for instance), and planning the center's future activities.

Ms. Chay inspects the result of recent seed multiplication activities.

Bounmy

J. Gorsuch

These children will inherit not only the challenges of rice farming but also a resource for meeting those challenges—the national rice germplasm bank.

In northern Laos, Walter Roder has put lifelong farming experience to work

Like the Lao people, Dr. Walter Roder has had a lifelong connection to farming. "I grew up on a small mixed farm in Switzerland," he says. "At that time… at least one son of a farming family had to become a farmer, to carry on the family business." But perhaps there was more to it than tradition alone. "Today the most satisfying moments in my life [still involve] working with plants and soil."

After working for a rural development project in central Bhutan, Dr. Roder went to work in Laos, a locale that he found more appealing than those who have read the poverty statistics might think. "A recent article in *Time* magazine… describes Luang Prabang as a slow and boring place. But… because of the research and the people I worked with, my experience there was exciting, challenging, and enjoyable," says Dr. Roder, who worked as an agronomist in areas with a slope of 12% or more (uplands).

Dr. Walter Roder conducted research on upland agronomy in Laos from 1991-95.

These challenges included the establishment of the Lao-IRRI office in Luang Prabang, and the initiation of collaboration between the IRRI upland program and the Provincial Agriculture Services Program of Luang Prabang province and Oudomxay district. Major research activities included documentation of traditional slash-and-burn farming systems, studies of soil fertility and weed dynamics, and development of weed management technologies and alternative cropping systems that emphasized soil conservation.

J. Schiller

In this hilly region of northern Laos near Luang Prabang, farmers have traditionally practiced slash-and-bum agriculture.

The research team has produced four major accomplishments:

- Increased awareness that policymakers and planners have of the needs of rice farmers and ethnic groups who live and work in sloping areas (uplands)
- Promoted more diverse production systems in the uplands
- Provided inputs for projects that work with farmers in the uplands
- Aided the personal and professional growth of national staff members who have collaborated with the project

Dr. Roder enjoyed the scientific activities, but it is the people that he remembers with the most enthusiasm. "I am most proud of the fact that we could build up a team of competent and motivated Lao researchers. Working with this team, a substantial research program was initiated and maintained," says Dr. Roder. "Through these activities, upland rice research in northern Laos was given a high level of importance, sufficient to attract global attention from scientists and others interested in the upland rice production system."

Dr. Roder developed a particularly high regard for rice breeder Suvit Pushpavesa. "During my tenure in Laos he was undoubtedly the most important person on the IRRI team. He was the only 'rice expert' of the team and also spoke the local language like his mother tongue and could easily relate to the farmers."

The dedicated professionals of this research team have, through their research and their own personal experiences, done much to inform others about this part of the world and the way in which its people produce food. And the expertise that they have developed and contributed is an additional legacy of the Lao-IRRI Project.

Like Dr. Roder, national scientist Lingkam Douangsila (center) and collaborator Ms. Karen McAllister have served a population that, proportionally, is more diverse than that of most countries. At this participatory rural appraisal (PRA), women from a local hill tribe wear their traditional blue-and-black clothing.

B. Linquist

J. Schiller

In addition to rice farming, daily village life includes the buying and selling of farm products at the local market (top) and the production of woven fabrics. Here (right), a woman prepares cotton that will be used for making cloth.

J. Schiller

In pursuit of plenty: John Schiller's commitment to his adopted country

Dr. John Schiller is passionately committed to working with the people of Laos.

Dr. Schiller, former team leader and research programmer of the Lao-IRRI Project, began his association with Laos in 1972 when he attended a conference in Vientiane on behalf of the Australian government. It was the start of a long-term association with the country.

"At the time, I knew relatively little about Southeast Asia," remarks Dr. Schiller. Upon completing his PhD studies, he had been scheduled to take up a position in Africa but a coup in the country to which he was assigned resulted in his going to Asia. He initially joined a group of scientists from the University of New England, Australia, in a project that aimed to stabilize areas of intensive cultivation in areas that had a slope of more than 12% (uplands) in northern Thailand.

With that project Dr. Schiller became aware of a rich interweaving of farming conditions, farming practices, and local cultures in the region. "In Indonesia, Malaysia, and Thailand, I supervised and led groups that studied upland farming, conservation of soil and water, land development, seed multiplication, soil fertility, households, land use, and yield," explains Dr. Schiller.

Those experiences prepared Dr. Schiller for what was to be an extremely rewarding assignment: in 1990 he became the leader for the Lao-IRRI Project. Lao-IRRI did not employ its own technical staff, but rather relied on developing the capabilities of Lao scientists and technicians for the conduct of the research. Dr. Schiller and his colleagues faced a prodigious task: build a national rice research capability in a situation in which nearly all research institutions had disbanded as a result of political changes in the region.

Dr. Schiller pays tribute to the national project coordinators who have been essential to the Lao-IRRI Project from the beginning. "The coordinators on the Lao side have been very important for giving us guidance on all issues relating to the country," says Dr. Schiller. "They also have provided a vital link between the Ministry of Agriculture and Forestry and the provincial agriculture and forestry offices." For the first eight years of the project, Mr. Viengsavanh Manivong filled this role; since 1998 Mr. Kouang Douangsila has filled the position.

In addition to learning about the official procedures within Laos, another challenge was to find national scientists in Laos with whom international collaborators could work. From 1983-90, very few people within Laos were employed in any field of agricultural research. Many Lao nationals went to study and train in the Soviet Union and Soviet bloc countries. When the Lao-IRRI Project commenced in 1990, only five young agricultural technicians were involved in basic field studies near the capital, Vientiane.

By 1997-98, much had changed. The national rice research program now employed 130 people and had been extended to include all 16 provinces of the country and a network of seven research stations. This change was the result of a tremendous commitment by the Lao government to support training and development of a national rice research capability in collaboration with the Lao-IRRI Project. Particularly strong backing has come from the Minister for Agriculture and Forestry and former IRRI board member, Dr. Siene Saphangthong.

Dr. Schiller also emphasizes that the recognized achievements of the Lao-IRRI Project were a real partnership between Lao national scientists and IRRI scientists. "Right from the beginning we worked to ensure a sense of Lao ownership of the national rice research program," says Dr. Schiller. Difficulties arose during the development years of the project; the greatest difficulties were those faced by the young Lao scientists and technicians. Despite low salaries and often difficult working conditions, they were always strongly committed, says Dr. Schiller. "They always said that they would be prepared to work and work hard; additionally they were keen to avail of opportunities for training and further studies," says Dr. Schiller. "I believe that the Lao-IRRI Project responded well to this need through the long-term and intensive training programs it supported."

Close partnerships have resulted in more than a decade of work to increase the food supply of Laos. During his time as team leader of the Lao-IRRI Project, Dr. John Schiller (left) worked in close association with Dr. Urs Herren of SDC in the development and operations of the project.

G. Hettel

J. Schiller

J. Schiller

J. Schiller

During his tenure with the Lao-IRRI Project, Dr. Schiller took many photos to document the daily lives of Lao farmers. This photo (above) shows a woman winnowing rice—a process that separates chaff from the edible grain. Other photos show a woman using a rice mortar to remove the husks (above right) and a woman carrying firewood (lower right).

Reflecting on the strong collaborative relationship between national scientists and IRRI scientists, Dr. Schiller recalls the work done by a group of dedicated nationally recruited staff (NRS) from IRRI (Dr. Bert Barrion and Ms. Hermie Rapusas) and their Lao partners, in undertaking a survey of the arthropod communities of the rainfed lowland and irrigated rice environments of the country in 1995. Researchers collected and identified more than 390,000 samples of insects from five provinces in the northern, central, and southern agricultural regions of the country. "They worked day and night over a period of a couple of weeks. It was absolute dedication," recalls Dr. Schiller. Benchmark information generated in this study is among the most detailed and complete for any rice-growing country in Southeast Asia.

In addition to support for the development of a national rice research capability in Laos, SDC has funded germplasm collection by the Genetic Resources Center (GRC) of IRRI and local collaborators. In economic terms Laos is extremely poor and therefore had few people to dedicate to the effort, but when asked *Should the collection of rice varieties take place?*, the Lao government answered *yes*. This commitment of human resources to the germplasm collection project was made possible through important linkages that Dr. Schiller and his colleagues were able to establish with the Lao government and with donors.

Germplasm collection activities were "absolutely phenomenal," says Dr. Schiller. From 1995 to 2000, IRRI germplasm collector Dr. Appa Rao and his Lao colleagues gathered nearly 14,000 samples of cultivated rice throughout the country. Unlike many rice collections, the results of these efforts are being immediately used in the national rice improvement program for Laos. Desirable characteristics of traditional varieties are being incorporated into improved varieties. A follow-up project, also funded by SDC, will document indigenous knowledge of farmers relating to the history, maintenance, and use of traditional varieties.

Along with Minister Siene, SDC has provided essential support. "Right from the beginning the Swiss have been an excellent donor," observes Dr. Schiller. "They understood that they needed to come in with a 10- to 15-year perspective. In a country like Laos or Cambodia, it is especially important [for the project] to have good working relationships with the donor and the management of the institution."

Over the past decade Laos has dramatically changed the way in which it grows rice. An expansion in the country's irrigated area allowed the country to become self-sufficient in rice production by year 2000. Also, between 1990 and 2001 the amount of land under new varieties has greatly increased. In 1990, 5% of the rice farming area was under new varieties. By 2001, 70-80% of the main lowland rice-growing area in the Mekong River region was grown to improved varieties, which were often selected at Ubon center in Thailand.

Dr. Schiller's current activities aim to extend further the benefits of new rice production technologies. An honorary consultant to the Rockefeller Foundation, Dr. Schiller seeks out projects for the donor organization to support. One such project involves rice banks that are run by the Lao women's union. Other initiatives seek to enhance agricultural education institutions within Laos and Cambodia. Lao institutions can develop further by forming closer partnerships with institutions in China, Thailand, and Vietnam.

Of his continuing involvement with Laos, Dr. Schiller says, "I've left Laos knowing and feeling that I will always be in contact with the people I've worked with. Part of my heart will always be in that area. I hope the feeling is mutual."

Khamouane Khamphoukeo uses acquired, indigenous knowledge in integrated pest management (IPM)

The son of a seamstress and a taxi driver/sharecropper, Mr. Khamouane Khamphoukeo was born and raised in Vientiane municipality (capital of Laos). Early on, he had the opportunity to learn about an activity that would become a lifelong profession. "I first became interested in agriculture when I worked in my parents' garden as a child," he says.

Mr. Khamouane attended high school in Vientiane and concentrated on agricultural studies. Among the top 15 students out of 300, he was awarded a scholarship upon graduation. "The scholarship was funded by the government of the USSR and gave me the opportunity to study agriculture in the USSR." Mr. Khamouane earned his first masters degree in plant protection. He then won a Norad scholarship and went on to earn a second masters degree in rural development planning and entomology from Kasetsart University in Thailand.

As a result of this academic work, Mr. Khamouane has acquired know-how that he combines with a lifelong familiarity with Laos. He now is an entomologist who heads the planning of integrated pest management (IPM) programs for Lao agriculture. "IPM for rice is my main interest," he says.

Boummy

Mr. Khamouane (right) discusses intercropping and IPM with Dr. Renate Braun, SDC junior program officer.

J. Gorsuch

Mr. Khamouane shows the author a snail (Lao name *seri*), a resident in the rice fields of Laos.

Mr. Khamouane continues to develop his abilities. He avails of training opportunities in Laos and Thailand, and at IRRI Training Center in the Philippines. This training has been supported by two projects: the Lao-Swedish Forestry Program and the Lao-IRRI Project. Mr. Khamouane is part of a critical mass of national scientists who have firmly established the NARES, a base upon which they can build now that the country has its own specialists on tap. "Before, we all had to go to other countries to receive training as agricultural scientists. Now we can learn from each other within our own country."

Mr. Khamouane plans IPM activities at the provincial, district, and village levels. "Now I see how the many levels of activity fit together: what the national research program wants to accomplish for the entire country, and how activities at the provincial, district, village, and individual levels contribute to that goal."

Currently Mr. Khamouane is collaborating with other scientists to organize and manage field trials throughout Laos that evaluate the effectiveness of various treatments in controlling rice bugs. "Each farmer's field is divided into four sections and each section receives a different treatment. The experiment began in July 2002," says Dr. Gary Jahn, a collaborating entomologist at IRRI.

The next major task is to develop a five-year IPM plan for Lao agriculture. "I am working with Dr. Jahn and other scientists to set up a workshop that convenes the IPM stakeholders in Laos," says Mr. Khamouane. "That way we can develop the plan together."

Local plant breeder Sengpaseuth Rasabandith seeks the right varieties

"If you start with the right variety, it lays the foundation for everything else," says Mr. Sengpaseuth Rasabandith, principal rice breeder and head of food crops at the National Agricultural Research Center (NARC) near Vientiane, Laos. "With the right seed, farmers have enough rice to consume." The challenge of finding the most suitable varieties for Lao farmers to plant has been his lifelong passion.

Boummy

Mr. Sengpaseuth Rasabandith, a pioneer in plant breeding activities for Laos, has particular interest in developing cold-tolerant varieties that can grow at high elevations.

For decades Mr. Sengpaseuth—born and raised in Vientiane—followed the stories that appeared in print. Scientists throughout the world, particularly in Asia, were working to develop improved varieties that offered high yield and good eating quality (aroma, good taste, and small grains). The articles about this work inspired Mr. Sengpaseuth to join the research effort.

A passion for plant science and a scholarship from the Lao government took Mr. Sengpaseuth to Vietnam to study agronomy. Next he went to Sri Lanka and Thailand, and then to the Philippines to study plant breeding at the University of the Philippines Los Baños (UPLB). Mr. Sengpaseuth also trained at IRRI as an advisee of Dr. Gurdev Khush, a world-renowned leader of efforts to develop higher-yielding, high-quality varieties of rice.

For Mr. Sengpaseuth, choice of profession was easy. "I knew that there were very few plant breeders in Laos, and that the work would be very challenging. I wanted the meaningful task of helping poor farmers in Laos to have good varieties to plant."

In 1989 Mr. Sengpaseuth joined the ranks of the small but critical mass of national scientists in Laos. His career as a plant breeder began at a time when the Lao government lacked money for conducting rice research, and he has been associated with the Lao-IRRI Project since the beginning in 1990. The project provided greatly needed resources, including his salary, and the funding for him to train in the Philippines.

From the beginning of his career Mr. Sengpaseuth has worked on varietal improvement; in the process he has become an expert. "Earlier in my career I planned individual experiments; today I coordinate experiments throughout the entire country," he says.

Mr. Sengpaseuth still goes to other places to train as needed, and tailors this knowledge to fit the conditions of his own country. This year he will spend two weeks in China to learn how China has attained an impressive yield of 17 tons per hectare for hybrid rice. He also will support the evaluation of 13,000 Lao accessions in China.

Today Mr. Sengpaseuth still collaborates with the Lao-IRRI Project, and because of successful capacity building his salary now comes from the Lao government. He continues his quest for the right varieties. "Thanks to the efforts of many Lao researchers and advisors such as Dr. Appa Rao from IRRI, I have more than 13,000 accessions to evaluate," he says. These accessions may be useful for developing cold-tolerant varieties for farmers who live at high altitudes in northern Laos where low temperatures currently limit the growing season to six months per year, unlike the year-round growing season in other regions.

Now that Laos has a solid infrastructure in place for conducting research on rice, Mr. Sengpaseuth sees exciting possibilities for international collaboration. "People in other countries have a very important role to play in the area of biotechnology. I would like to work with IRRI to make anther cultures. Foreigners have the resources to do anther cultures. Laos doesn't." Anther cultures, for instance, offer a shortcut for breeding a particular characteristic (such as aroma) into an accession because they require less time than the growing out of several generations of rice plants. Anther cultures take only one year; traditional backcrosses take five to six years.

This and other partnerships would mark a new phase of research for Laos, one that incorporates high tech resources into what has become a considerable amount of work to improve the livelihood of Lao farmers.

Training

cultivation of agricultural professionals

J. Gorsuch

Students at Phone Ngam Station in Champasack province are training to become agricultural extension agents. When they graduate they will return to their villages to share their knowledge with families and neighbors back home.

Student shares her knowledge with farmers back home

Aswam is carrying out her entire five-month practicum at Phone Ngam Station in the southern province of Champasack. She is taking data for an experiment that began three years ago, comparing varieties of aromatic nonglutinous rice.

"I am studying agriculture because I want to supply the farmers in my village with new technology that will help them to grow more rice. When I complete my coursework I will return to my village to become an extension officer in a district agriculture and forestry office (DAFO)," explains Aswam through a translator. Aswam plans to use her newly acquired knowledge of rice farming and research in two ways: as an extension officer and also as a farmer on her two hectares of land. That she can pursue these goals is evidence of the success that Laos has had in capacity building over the past few decades.

Like 50% of her classmates, Aswam has a father who works in an agricultural extension office. (The other 50% of students have fathers who are rice farmers.) This group of about 12 is predominantly female and may indicate that the demographics of local agricultural extension offices are about to change. Aswam is one of four children and, like her classmates, has completed more than three years of academic coursework at an agricultural college in Pakse. Study in the first and second year is general; in the third year, students choose either livestock or plant crops as an area of specialization. Aswam has chosen plant crops.

Aswam is able to study agriculture thanks to the financial support of donors such as SDC and the Lao government. The Lao-IRRI Project and a number of other collaborative development projects and nongovernment organizations (NGOs) provide support that allows Aswam and other students like her to undertake their training at research centers within the national rice research network. The national government administers the funding for agricultural education in Laos.

These students are an example of the long-term commitment that IRRI has to the people of Asia. They learn from rice researchers, become extension officers, and work with former classmates and former instructors for decades to come. Technical knowledge and personal relationships give them the potential to help hundreds of farmers in the area, and to continue the work of extension officers who have come before them. This capacity building has yielded a high return, financially and personally. Thanks to a continuity of training, extension officers have helped farmers in Champasack province to use more new technology than they did 10 years ago. Adoption of improved varieties and use of nutrient and pest management have more than doubled local yields of rice: from as low as 1.5 tons per hectare in 1990 to as high as 4 tons per hectare in 2000.

J. Gorsuch

Partly as a result of successful training courses and partly due to her own innate ability, this Lao extension officer (standing, at chart) has developed skills that she can use for acquiring participatory input from local farmers to help them evaluate the needs of their upland village.

J. Gorsuch

Dr. Phoudalay Lathvilavong, chief of Thasano Station, Savannakhet province (southern Laos), talks about her interest in learning to use SAS, a statistical program. To her left is Dr. Renate Braun, SDC junior program officer.

Training is the vital complement to research

Nondegree and degree training has built the research capacity of Laos by developing a core of knowledgeable extension agents and scientists within the NARES. Between 1990 and 2001, Lao nationals filled 2,306 places in training and workshops.

J. Gorsuch

Local researcher Somphet (back, doorway) and a local extension agent (wearing hat, in doorway) draw on their training when they facilitate this meeting with Lao farmers. Farmers in this upland village tell national staff about day-to-day problems on the farm: low crop yields and death of livestock are particularly common.

J. Gorsuch

Dr. Phoudalay surveys an experimental plot. An important resource person within the NARES, she began collaborating with the Lao-IRRI Project in the early 1990s after completing her studies in Tashkent, Russia. She developed research leadership skills by participating in short-term specialized training at IRRI. Dr. Phoudalay now trains students—the Lao scientists of the future.

National Agricultural Training Center: Laos-based training

Training opportunities include nondegree training; degree training; specialized training; training that is in-country or at IRRI headquarters in Los Baños, Philippines; and international training, conferences, workshops, and other events.

Nondegree training. Until a critical mass of Lao nationals can offer in-country instruction in every major aspect of rice research, Lao nationals avail of training opportunities throughout Southeast Asia. Over the past 11 years, the IRRI Training Center in the Philippines has teamed with universities in Thailand to offer nondegree training for Lao nationals.

Degree training. Several Lao nationals have undertaken study that enables them to earn masters degrees. Fifty percent of all participants in degree training have attended courses in Thailand to obtain an MS degree or to qualify for an MS degree program.

Specialized training. IRRI Training Center in the Philippines has offered 20 specialized courses over the span of 11 years: Basic Rice Production Course Development (taught in Lao language), Small-Scale Farm Tools and Equipment, Design and Analysis of Field Experiments, and Seed Multiplication. By participating in these courses, Lao nationals have acquired basic knowledge of rice science; now they can apply that knowledge to the unique conditions of their own country.

In-country training. In-country training offers two significant advantages over out-of-country training: high technical relevance (trainees learn material in the context of local conditions) and greater financial efficiency (finance the travel of a few instructors to Laos rather than send many participants to other countries). Courses have included Soil Fertility Research Management, Varietal Improvement, Rice Germplasm Collection, and Basic English. The most important of these is Basic English.

"While there are plenty of good training opportunities most Lao do not have the English capacity to attend," explains Dr. Bruce Linquist, upland rice agronomist of the Lao-IRRI Project. The latest discoveries in agricultural research are communicated in the English language. Local researchers and extension officers need to know English in order to participate in training courses or degree programs outside of Laos. To make this information directly accessible to local agriculturists, the Basic English course is available to Lao nationals.

Basic English courses represent a large portion (approximately half) of all training programs in Laos. They are essential for helping local researchers and extension agents to understand and apply the results of agricultural research. Basic English is by far the most popular in-country course: 776 slots have been filled by Lao nationals in English classes that were either intensive (565) or part-time (211).

The Basic English course is for Lao trainees who work in the national rice research program. The coursebook incorporates reading material from the local and foreign press, and subject matter covers agriculture, economics, culture, health, and scientific research. Students who successfully complete Basic English can enter a language course in technical English such as Agricultural English, which is offered at IRRI Training Center in the Philippines.

Training at IRRI headquarters in the Philippines. At IRRI Training Center in the Philippines, participants in the course Principles and Practices of Farm Management learn skills for farming in an efficient, environment-friendly, and sustainable manner. One such course recently attracted several participants from Laos. Trainee Vorachith Sihathep remarked, "[During the course] we must plow in a perfectly straight line, within a certain number of minutes, because when we go back to our countries we will train and supervise others who plow the fields."

Monitoring and study tours, conferences, workshops, meetings. IRRI-sponsored events have included monitoring and study tours of the Lao countryside for germplasm collection, as well as in-country workshops to plan training and research activities for Lao NARES. Over the past 11 years, up to 245 participants have attended conferences, workshops, and seminars. More than 32 Lao nationals have participated in study tours.

Minister Siene: supporter of project's training efforts

The effectiveness of training as a tool for capacity building is due in large part to personal backing that national leaders such as Minister of Agriculture and Forestry Siene have given the Lao-IRRI Project in the pursuit of this goal.

J. Gorsuch

Students at Phone Ngam Research Station, Champasack province, train to become extension agents. After their training they will return to their villages to help their neighbors grow more rice using high-yielding varieties and sustainable practices.

Training boosts idealism, promises career mobility

One challenge for the immediate future is to clarify the opportunities that are available to Lao staff for research and public service. Membership and activism in government organizations remain important for career mobility in Laos. This activism offers a potential benefit for the research sector: it encourages idealism, particularly the willingness of national staff to work hard at their research for the sake of their country.

Such idealism is important. NARES salaries tend to be low; the spouse of the scientist usually must earn most of the income for the household. Dr. John Schiller, former team leader for the Lao-IRRI Project, comments, "I developed great personal admiration for many of our Lao colleagues who were prepared to work well under these conditions." National staff have been motivated to avail themselves of opportunities for technical training and the upgrading of their formal qualifications.

The Lao have committed themselves to the ideals of the project, and to further training and study. With this continued commitment to their country and their work, it is likely that these trained scientists and technicians would continue to dedicate themselves to a career of agricultural research in the government sector, and to generate and disseminate the scientific information that helps their fellow citizens to live better lives.

Dr. Appa Rao (center), an expert in the collection, classification, and storage of rice germplasm, explains a technique for measuring the dimensions of rice seeds at the National Agricultural Research Center (NARC) in Vientiane.

G. Hettel

Genetic conservation

Lao people bank on biodiversity

A. Rao

Each grain of rice contains a genetic code that is thousands of years old. This genetic record performs several invaluable functions:

- Chronicles the heritage of rice farming
- Perpetuates varieties of rice and therefore maintains biodiversity
- Maximizes the number of options a rice farmer has for growing his or her crop

The Convention on Biological Diversity, implemented in 1993 and acceded to by Laos in 1996, defines biodiversity as the variability among all living organisms: species and genes, and the ecosystems that they create.

Ecoagriculture, or land use that combines agricultural production with other activities, promises to improve dramatically the way in which we grow rice. For instance, the planting of more than one variety of rice per field in parts of Asia has slashed the need for chemical inputs by slowing the spread of rice blast disease. It also has boosted rice yields in some areas by as much as 89%.

Rice farmers in Laos face a host of day-to-day challenges: pests, depletion of nutrients in the soil, changeable availability of water, health problems of livestock and family members, and a high rate of child mortality due to disease.

Conservation of plant material and seeds in Laos has preserved thousands of rice varieties that otherwise would have disappeared forever. Scientists have appreciated the generosity of the Lao government in supporting the collectors and providing IRRI with samples—especially considering the current trend of nationalizing genetic resources. States have sovereign rights over germplasm that is found within their borders.

A. Rao

(left) His Excellency, the Lao Minister of Agriculture and Forestry Dr. Siene Saphangthong, a vital supporter of the Lao-IRRI Project, tours a village to see the impact of germplasm collection at the local level.

SDC's commitment to biodiversity

The choices afforded by biodiversity and ecoagriculture are vital tools for dealing with changes that take place over time within the rice farming ecosystem. Pests, predators, and local environments change over time and overcome the resistance of the rice plant. To prevent massive crop losses and to help the Lao people preserve one of the most diverse sets of rice genes in the world, SDC funded a project called "Safeguarding and Preservation of the Biodiversity of the Rice Gene Pool."

"Our support of long-term projects shows that we are committed to preserving the tremendous diversity of rice and to slowing the process of genetic erosion and the decline of agrobiodiversity," says Dr. Urs Herren, former Hanoi-based deputy regional coordinator for SDC. Addressing the issue in three dimensions as outlined in the Convention on Biological Diversity, SDC promotes diversity in agro-ecosystems (watersheds, cropping systems, pastures), among species, and within species (e.g., rice). "Many factors that contribute to the reduction or enhancement of biodiversity in these areas are directly linked to agricultural policies and practices," says Dr. Herren.

This project has been critical for Laos, a country that contains many "biodiversity hotspots": areas that are species-rich but are quickly losing those species due to rapid population growth and human settlement. Laos also has a population of which more than one-fifth is undernourished, and a high rate of population growth: 2.5% per year—one of the highest rates in Asia. Agriculturists seek a level of rice production that can at least match population growth.

Three-way partnership makes Biodiversity Project possible

In 1994, the Lao government, SDC, and IRRI began working in a three-way partnership to collect and store precious germplasm (plant material and seeds) for rice, as a way to prevent that material from being lost forever. Collection, characterization, and storage of the materials have been part of a larger effort that included 23 countries altogether: Laos and 10 other countries in Asia, as well as sub-Saharan Africa and Central America. The Biodiversity Project had three goals:

- Attempt to complete the collection of rice germplasm by 2000,
- Strengthen genetic resource-conserving capabilities of national programs, and
- Study the on-farm conservation of rice genetic resources.

The Biodiversity Project has enabled the international team to collect more than 26,000 samples of cultivated and wild rice worldwide, many of which are from areas

Local names contain priceless information. By using everyday local words to name the traditional varieties that they grow, local farmers assign indigenous descriptions that many nonlocals find quite colorful. The large number of names, and the names themselves, reflect back the many diverse varieties of glutinous and nonglutinous rice that grow in Laos. "When collecting the seeds, we've been extremely conscious of also gathering information from the farmers about a variety's origin, special traits, and significance—including the vernacular name and its translation," explains Dr. Appa Rao. A small window of time exists for collecting this priceless treasure of farmers' knowledge, to keep this treasure from being lost forever.

During collection expeditions in Laos over a period of five years, Dr. Appa Rao and his Lao colleagues have gathered 3,104 distinct names and their English translations. "Imperfect as literal translations sometimes are, they... give an insight into the rice variety and the nuances involved," says Dr. Appa Rao. "A variety named *Tom* (muddy) once led me to believe it was in reference to poor taste, but upon talking to the farmer, I learned that the name is more related to grain color." *Turtle shell* may refer to the shape of the grain. *Fat* is a term associated with good taste. *Neglected fields* means the variety can grow under poor soil conditions. *Watching dog* means poor quality: even a dog is uninterested in eating this variety—he only looks at it.

Some names explain the cultural aspects of rice. The variety *Mae May* (widow) produces some unfilled grains, while *Mae Hang* (divorced woman) produces a lot of grain and keeps the woman so busy harvesting the bountiful crop that her impatient husband leaves her. *Khao Poum Pa* (rice in fish stomach) originates from grains that came from the intestines of a fish. "Fish (*Pa*) is an important part of the lives of the Lao people," says Dr. Appa Rao, "so many names are fish-related. Tiny carp (*Pa Siev*) would mean the grains are slender and long.

Dr. Appa Rao hopes to compile these names and their folklore in a book called *Traditional Rices of Laos*.

that have previously been unexplored. The large number of rice varieties within Laos—more than 3,000—means that collection efforts in this country have been a major part of the Biodiversity Project.

Within Laos a three-way partnership between the national government, SDC, and IRRI has been highly successful. Lao government officials such as Dr. Siene have facilitated communication between the Lao government and international organizations, while Lao staff members such as Ms. Chay Bounphanousay have made possible the collection of samples of germplasm; SDC has funded the project; and IRRI scientist Dr. Mike Jackson has supervised the entire project. Another IRRI scientist, Dr. Seepana Appa Rao, has trained and advised Lao national staff and has supervised the collection and storage of germplasm.

Strategy for collecting

Germplasm collectors have worked to maximize diversity while collecting a minimum number of samples. The team has worked to collect at least one sample of each variety from each district and to obtain samples from farmers' fields, threshing floors, or grain stores. Farmers sometimes call different varieties by the same name or use different names for the same variety, so the team has collected duplicate samples in cases of doubt.

Collecting activities have been a joint effort between the germplasm unit at NARC and Dr. Appa Rao. Additionally, extension officials at the Ministry of Agriculture and Forestry (MAF) have carried out collection missions during the months of September through December one week before harvest, and have continued until threshing.

Collectors have gathered four types of rice:

- *Traditional cultivars*—lines that are grown from seed, passed down from generation to generation, and selected over time for adaptability and desirable grain quality.
- *Slightly improved cultivars*—lines that are developed by mass selection from more popular traditional varieties such as Ta Khiet, Do Lay, Nang Noua, Horn Nang Noua, and Sampathong Do.
- *Weedy intermediate rice*—hybrids that result from natural outcrossing between wild and cultivated rice, often found around field borders that are adjacent to the cultivated rice crop.
- *Wild rice*—species that are found growing on the bunds of cultivated rice fields, roadside ditches, ponds, canals, mountain slopes, forests, and other areas that are not regularly cultivated.

Collection and preservation of traditional varieties make possible the development of improved varieties for Laos because these varieties often are already well adapted to local growing conditions. One major part of this effort is the selection of traditional varieties that are best suited to areas that have a slope of more than 12% (uplands). Although the Lao government is promoting lowland cultivation and other alternatives to the upland cultivation of rice, it is important to have varieties that are suited to upland conditions because many farmers in northern Laos continue to have no choice but to grow upland rice. Farmers test the selected varieties under on-farm conditions that they themselves manage.

Organizational type	No. of samples
CGIAR system	71,065
University	44,081
Genebank programs	8,176
National programs	4,045
Private	1,469
NGOs/other organizations	736
Individuals	173
Regional organizations	31
Total	**129,776**

Source: International Rice Genebank

Another major part of collection and preservation of traditional varieties is the study of samples of nonglutinous varieties of lowland rice. Sixty of these have been crossed with other lines. Breeders are evaluating 23 lines of "black rice" that have purple pericarps and will be useful in the development of high-quality varieties for export that could bring in greatly needed foreign exchange. Additionally, 300 samples of aromatic glutinous varieties are being evaluated for the possible development of high-quality export rice. Early results are promising.

Laos, a small country that until recently has had little access to modern technologies, is the source of some of the most diverse varieties of rice in the world. This diversity has already greatly enriched the world's collection of rice seed. Moreover, the seed collection in Laos provides a centralized resource that local people can use to develop new and improved varieties.

In Laos, most meals include glutinous (sticky) rice. People use their hands to eat glutinous rice, just as they would to eat a piece of bread.

J. Gorsuch

Conservation: the circular path

Now that thousands of samples have been collected, the Lao government has given IRRI the honored role of guardian for some of the country's most precious germplasm. Within IRRI, the Genetic Resources Center (GRC) provides long-term conservation of rice genetic resources at its International Rice Genebank (IRG).

Long-term conservation is a form of "genetic insurance" for rice farmers and their varieties. Samples of rice varieties have moved along a circular path: from farmers to Lao technicians, then to the Lao government, then to IRRI, and ultimately back to the farmers. In this way, varieties that are "lost" to war, famine, or other misfortunes can be safeguarded for replanting when circumstances improve. IRG is the custodian of more than 108,000 samples of cultivated rice and wild species, most of which are traditional varieties of *Oryza sativa*. Through IRG, nearly 130,000 samples have been distributed to people in 68 countries between 1993 and 2002.

These samples include many varieties that are unique to Laos: aromatic, glutinous (sticky), and nonglutinous varieties that grow in flat and hilly environments alike. How did these varieties come to grow in Laos? Geographically and historically, Laos lies within the center of the presumed origin and domestication of rice in Asia. As many as 6,000 years ago, local people began growing and eating varieties of glutinous rice that were not grown elsewhere. Locals still prefer these varieties over all other kinds of rice.

Although the Lao people have a strong preference for the eating qualities of traditional varieties, farmers in the central and southern provinces have been quick to adopt improved varieties because of the large increase in yield that they offer. In anticipation of the widespread adoption of these new varieties, collection of germplasm samples in Laos began before the use of improved varieties could overtake the use of traditional ones. Lao farmers, a tremendous asset to the project, allowed collectors to select panicles from plants that the farmers were harvesting,

G. Hettel

Dr. Appa Rao and Ms. Chay Bounphanousay inspect a drawer of germplasm in the Lao Germplasm Center at the National Agricultural Research Center (NARC) near Vientiane.

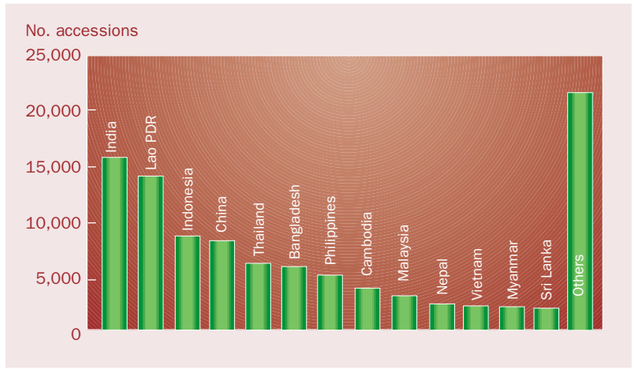
and donated about 125 grams of seed from their varieties. They also shared their indigenous knowledge about traditional varieties of rice that they were growing. Moreover, extension agents were highly motivated to carry out the collections.

Benefits of project for Laos

The Biodiversity Project leaves behind a valuable legacy for this small country and for those with whom the Lao choose to share this legacy:

- On-farm conservation.
- Training of national staff.
- Creation of a comprehensive germplasm collection of rice varieties that are found only in Laos. Germplasm is being used to identify superior varieties for rice farming in the uplands.
- Development of a national genebank facility. SDC financed construction of the first cold storage facility in Laos. In 1995 this small medium-term storage facility was built at NARC near Vientiane. Recently the facility acquired three deep freezers that can store samples at –18°C for 10 years or more (long-term).

The benefits are especially impressive when considering the economic return on this investment. Dividing SDC funds spent directly on germplasm collection by the number of samples, per-sample cost is well under US$20. "That is quite inexpensive for something so irreplaceable," says Dr. Mike Jackson, GRC head during the Biodiversity Project and current director of research program planning and coordination at IRRI, "even considering that there are duplications in the country collections. Amortizing that cost over the next 100 years, the incredible bargain and what will be an astronomical return on the investment in terms of variety improvement become readily apparent."



This chart shows the status of the collection in the IRG. Much of this germplasm was donated to IRRI by national agricultural research and extension systems (NARES). At just under 15,000 accessions, Laos has contributed more samples to IRG than any other country, except India. Source: IRRI Genetic Resources Center.

Legacy of knowledge, awareness

The Biodiversity Project leaves behind another legacy as well: knowledge of techniques that can conserve other crops (such as maize) in addition to rice, and increased awareness of the importance of conserving plant genetic resources.

This legacy has a strong cultural component. Now that germplasm has been collected, extension agents and researchers are working with farmers to collect important indigenous knowledge: folklore, anecdotes, interesting names for rice varieties, and uses for traditional varieties. Like the genetic record, this cultural record is a vital resource for the future.

SDC-financed construction of a rice genebank at NARC headquarters means that most of a typical 125-gram sample stays in Laos.

Improved varieties

self-sufficiency, cold tolerance

"Since 1999, Laos has become self-sufficient in rice production and has exceeded its self-set target of producing two million tons of rice per year," says Mr. Karl Goeppert, IRRI representative to Laos and team leader of the Lao-IRRI Project. Having attained this unprecedented goal, the country now seeks to increase its exports of rice. Rice exports earn foreign currency with which Lao people can buy foreign goods, invest in new businesses, and increase the country's GDP. Organic rice in particular might be the best product for earning foreign currency.

Varietal improvement: search for a niche product

"It may be possible for Laos to export organic rice as soon as 2006 or 2007," comments Mr. Sengpaseuth Rasabandith, principal rice breeder in the national rice research system. During the 1993-94 growing season, researchers began to evaluate about 500 samples of traditional varieties that were aromatic and glutinous, for possible development of organic rice for export. Laos is unable to compete with Thailand in the market for high-quality rice that is conventionally grown, but production and export of organic rice could be a very successful niche market for Laos. During the 1997-98 growing season, the national program released five varieties to farmers in 10 out of 17 provinces in Laos.

These varieties are suitable for central and southern Laos, where individual plants for these varieties are photoperiod-sensitive (sensitive to daylength) reach maturity within 130 days. Central and southern Laos get more than 10 hours of sunlight per day year-round. These same varieties would be late-maturing in northern Laos, reaching maturity in 150 days because of high elevation and therefore low temperatures and fewer hours of sunlight per day. In the north, mountains and clouds partly obscure the sunlight and therefore the region receives only about six to seven hours of sunlight per day year-round.

Improved varieties from Laos and Thailand are crossed with improved varieties from IRRI. Improved varieties from Laos come from the hybridization program with IRRI, Thailand, and Vietnam. The hybridization program started in 1992-93 and worked with high-yielding varieties from all over Asia that were adapted to Lao conditions.

The National Agricultural Research Center (NARC), the headquarters for the varietal improvement program, has benefited greatly from linkages with other organizations. Along with six substations throughout Laos, NARC has worked closely with the Australian Centre for International Agricultural Research (ACIAR) on drought tolerance and cold tolerance, and with the Comonwealth Scientific and Industrial Research Organisation (CSIRO) to conduct research on rodent pests of rice. Another organization, the Rockefeller Foundation, just began funding a drought screening conference that took place at IRRI 27-30 May 2002.

Individuals have also contributed a great deal to varietal improvement efforts.

J. Gorsuch

These bags contain the product of seed multplication efforts, by which the seeds of a rice variety are grown out to produce more seeds that farmers can then grow and evaluate in their fields.

Dr. Edwin Javier, a scientist at the International Network for Genetic Evaluation of Rice (INGER) and IRRI, has collaborated with national scientists who maintain a cold tolerance nursery and a nursery for growing plants that produce aromatic and fine (slender) grain. Another individual is a potential collaborator. "I would be very interested

to work with Dr. John O'Toole," says Mr. Sengpaseuth. Dr. O'Toole is renowned for his studies of drought tolerance and may be able to help with research on cold tolerance, which is particularly important for northern Laos.

Wanted in northern Laos: cold-tolerant varieties

Many Lao live in six northern provinces. Cold-tolerant rice varieties need to be developed because 200,000 hectares are farmed during the wet season; fewer than 30,000 to 50,000 hectares are irrigated during the dry season. Northern Laos is mountainous; therefore farmers cannot plant rice year-round because of low temperatures (November through April). Temperatures can sink below 0°C during the month of January, and below 15°C during other months. People who live in these regions have plenty of land and water (especially along the valley), but the climate is too cold for continual cropping of rice.

Phasing out opium, slash-and-burn: complementary strategies

The Lao government is employing complementary strategies to improve the lives of farmers in northern Laos. The first strategy is to stop the growing of opium and eradicate the accompanying crime and health problems. To date, profit has been a compelling incentive to cultivate this addictive product. One family can earn about one million kip per year growing opium. For some, this substance has been a poor substitute for a nutritious diet. Opium cuts the hunger pains of farmers who grow too little rice to feed themselves from day to day.

The second strategy is to stop slash-and-burn agriculture (which is used for growing upland rice), in order to protect the natural environment and encourage the use of higher-yielding rice farming practices such as lowland farming and irriagation, and the use of higher-yielding rice varieties.

By working to build support among local farmers for these two strategies, the government expects to effect these strategies in the years ahead. Cold-tolerant irrigated rice may bring in less income than opium, but it will feed farmers and improve their quality of life by taking away the need for opium and reducing the number of opium addicts. Cold-tolerant varieties from China, Japan, Korea, Philippines, Thailand, and Vietnam offer potential for producing more food in northern Laos.

Observation yield trials such as this one are important in the development of rice varieties that feed farmers and also offer business opportunities—trade in rice that has sought-after qualities.

Organic black rice: a hot export crop?

When crossed with each other, some varieties may offer both high yield and good eating quality. This possibility motivates plant breeders in Laos to seek winning combinations of genes. Breeders have evaluated 23 lines of "black rice," a type of rice that has purple pericarps and potential use as an export item.

After on-farm testing of traditional varieties, Khao Dam (black rice) and Khao Vieng (photoperiod-sensitive rice) were released to farmers in 1999. Farmers like the good eating quality as well as the high yield: about 2.5 to 4 tons per hectare, depending on soil fertility.

Farmers who produce and export these unique varieties of rice may reap substantial rewards. Black rice is more common in Laos than anywhere else in the world, which means that local farmers could have a tremendous advantage. The potential market for black rice is enormous: European countries, Japan, Korea, the United States, and various airlines already buy and use black rice for New Year celebrations, special meals, or rice cakes. In addition to its excellent aromatic eating quality, black rice is much more nutritious than white rice and also is easier on the environment. (It is organically grown.)

By way of comparison, regular rice fetches about 1,800–2,000 kip per kg; black rice fetches nearly double that amount: 3,000–5,000 kip per kg. In order to earn a profit, farmers who grow black rice would need to charge a price that was high enough to compensate for decreased yield; currently the yield of black rice is equal to or lower than the yield of regular rice.

(above) Black rice that is cooked and served within a section of bamboo is popular at roadside stands (right) or even among passengers on a bus like this one in southern Laos (lower right). All photos by J. Gorsuch.

Current practices, new variety: a good match?

Aside from the adoption of a new variety such as black rice to grow in their fields, farmers' current practices may need to change very little and may actually be well-suited to a specialty crop such as organic black rice. Farmers use labor-intensive methods, grow more than one variety at a time, and thus stagger the maturity to spread out the workload. A limited labor force does not have to harvest an entire area at once.

For farmers in northern Laos, black rice would ideally be cold-tolerant and therefore have a chance of being a medium- or late-maturing variety. Medium- and late-maturing varieties have the highest yields because unlike early-maturing varieties, medium- and late-maturing varieties have more time for the reproductive stage. Currently, varieties grown in the north are early-maturing so that farmers can harvest them before the weather turns cold.

Nonglutinous rice: another potential export

Between Vientiane and the southern province of Savannakhet, national researcher Kham is conducting observation yield trials in a field that is irrigated with water from nearby Nam Sang River. The first of three sets of trials, this initial screening selects nonglutinous rice varieties with the most promise of consistently high yields.

Why would a nation of people who eat sticky (glutinous) rice be interested in growing nonglutinous varieties? To answer this question, look across the Mekong River or elsewhere along the national border. Rice consumers in neighboring countries (and even at restaurants in Laos) have a large appetite for the fluffier, lighter texture of nonglutinous rice, indicating a significant market for Laos-grown nonglutinous rice.

Export quality, high-yielding, and cold-tolerant varieties of rice would offer an additional dimension of success to the Lao farmer's quest for a better life. Several milestones are in sight: development of a robust trade in high-yielding nonglutinous rice, increased rice production at high altitudes, and development of a niche export product—organic black rice. Through collaborative work, it is likely that farmers, extension agents, and plant breeders in the national rice research program would reach these milestones.

Rice bugs

piece of an ecological puzzle

In a small village in Champasack province, people are searching for clues. They want to be prepared for an invasion that will come from the nearby forest.

Since the late 1990s *Leptocorisa oratorius* (Fabricius), a common species of the insect known as rice bug, has made its annual migration from the rice ecosystem to the forest and back. For the unlucky farmers whose fields become infested, the consequences are disastrous. Several will lose their entire crop and go deeply into debt. Assaults by the rice bug always coincide with a large loss to the rice crop, but evidence against the rice bug is only circumstantial. At this point, researchers know that rice bugs suck out the contents of the rice grain. The search for any causal link that may exist between outbreaks and crop loss involves the piecing together of information about local practices and local ecology.

An emerging problem

Rice bug infestation is a problem that has emerged only recently in Laos. Rice bug outbreaks began after farmers started growing more than one crop per year. Overall, intensified cropping has been a good thing for farmers. "My family has more food and income than it did before. Other families in the village also can afford more food, clothing, medicine, and education," states Samboun, a farmer in southern Laos, through a translator. However, rice bugs also thrive on this new pattern of cropping. Rice plants, now available year-round, are their food of choice.

Rogues gallery: (left, below center) Rice bugs rest on leaves in this local forest. Rice fields that border forested areas are at risk of being overrun by rice bugs. "Natural enemies" of the rice bug help to keep a population of rice bugs in check by feeding on rice bugs.

Photos by J. Gorsuch
Puzzle design by Jeremy E. Mac

Knowledge-based arsenal

Initially, nervous rice farmers sought to protect their food supply by arming themselves with weapons that were officially banned yet conventionally used: sprayers and insecticides. Today national and international researchers are helping farmers to assemble a knowledge-based arsenal that promises to be less toxic to the environment and more effective in the management of destructive insects.

For instance, agriculturists now understand the pattern of infestation. "Rice bugs immigrate to a rice field from the forest during the cropping season. After the crop is harvested, bugs emigrate from the field back to the forest," explains Mr. Khamouane Khamphoukeo, a national scientist. Research is needed so that the Lao government can predict outbreaks for certain months, locations, and varieties. There are already some clues. For instance, late-maturing varieties in Savannakhet province tend to be most vulnerable because their grains ripen in time to provide food during the insects' time of reproduction.

What's the connection?

Researchers now seek another piece of the puzzle: data that would indicate a clear connection between rice bug infestation and crop loss. In Laos and the Philippines, IRRI researchers are measuring the economic impact of rice bugs. "If a farmer consistently loses half of his or her crop when rice bugs infest the field at a certain density, then density of rice bugs in a future season would indicate how much of that crop the farmer could hope to harvest, eat, and sell," explains Dr. Gary Jahn, entomologist at IRRI. More conclusive data about economic losses caused by rice bugs would allow agriculturists to assess the risk of crop loss. Better information means better planning by farmers.

After severe infestations of rice bugs, farmers in Laos have observed reduced yields, grain quality, and seed viability. Measurement of this decrease is a challenge to agriculturists who must quantify many variables on the small scale of a typical Lao farm. Such data will be used to help farmers decide whether they should attempt to control rice bugs. The decision will depend on the actual cost to control the pest. This varies from season to season

Grain formation includes three phases, within which are several stages (listed in sequential order):

Vegetative phase
- germination stage
- emergence stage
- seedling stage
- tillering stage
- panicle formation stage

Reproductive phase
- spikelet emergence/booting stage
- heading/opening stage

Ripening phase
- milk stage
- dough stage
- yellow ripe stage
- maturity stage

Underlined stages are the ones at which rice plants are most at risk of rice bug infestation.

A. Barrion

Lynx spiders (*Oxyopes javanus* – Thorell) feed on the rice bug and may be important for biological management of rice bugs in the future.

Do rice bugs cause the formation of hollow grains? The total effect of rice bugs on rice crops is unclear. Agriculturists have gathered data on the timing and nature of infestations by rice bugs, but before they can measure damage that is caused by rice bugs, they must confirm whether *Leptocorisa oratorius* actually causes any of the documented damages.

Conclusive data on the effect of rice bugs continues to elude scientists. Two different studies indicate two different timings and results of infestation. Study one took place in a laboratory. It shows that rice bugs feed on spikelets prior to flowering. Later, grains are hollow when they form. Study two took place in farmers' fields. It shows that infestation by rice bugs occurs after flowering. Later, grains are partially filled (but not hollow) when they form.

Study one generated other interesting results. At the highest level of infestation, feeding by rice bugs resulted in significantly lower yields and germination rates than in uninfested checks in all cultivars. The percentage of unfilled grain was significantly higher in infested plants than in uninfested plants for all cultivars. In all four rice cultivars that were tested, number of rice bugs correlated negatively with yield, grain quality, and seed viability. Researchers concluded that infestations of *L. oratorius* have the potential to cause significant reductions in yield, grain quality, and seed viability.

with the price of rice (income) and the cost of control measures.

Biological pest management: sustainable, environment-friendly

Natural biological management reduces reliance on insect control methods that are costly for farmers and/or harmful to the environment. As part of their commitment to sustainable farming practices, national agricultural specialists, IRRI scientists, and their collaborators encourage natural biological management. This practice cultivates the presence of insects that keep the population of rice bugs and other insect pests in check. At this point researchers have a few clues that help them to formulate a plan for natural biological management. They know that lynx spiders (*Oxyopes javanus* – Thorell) feed on the rice bug. Also, they suspect that the odor produced by rice bugs repels certain predators.

On the trail of rice bugs

How does anyone know which rice grains have been fed upon by rice bugs? Rice bugs leave protein sheaths inside and on the surface of rice grains. Researchers in Laos and the Philippines use these clues in their search for any connection between appearance of the pests and incidence of hollow grains. They ask three questions:

- How many rice plants have protein deposits on the surface?
- How many rice plants have hollow grains?
- At what stage do rice bugs infest the plant?

Peer influence: incentive to adopt new practices

Peer influence is yet another piece of the puzzle. Peer influence and a shortage of labor may help explain why many rice farmers consistently seem to lack effective practices for weeding their fields.

"Weeding might be more effective than current insect control practices as a way to manage rice bugs," proposes Dr. Jahn. Rice bugs live in all kinds of grasses, including weeds. Better, more frequent weeding may help reduce the population of rice bugs because it removes grassy plants that rice bugs live in during the nymph stage of their life cycle. If researchers adopt a proposal that is under consideration—studying economic impact, management, and movement patterns of rice bugs in Laos—then this information could clarify the role that grasses play in the life cycle of rice bugs.

Such clarification could help farmers adopt practices that are more beneficial to their families. Farmers who lose much or all of their crop go into debt for long periods of time in order to feed themselves. To avoid this problem, some farmers successfully spread risk by diversifying the crops that they grow. Or they grow a mix of varieties, some of which are sensitive to daylength and some of which are not. Farmers who diversify their crops or varieties may lose only 30% or less rather than an entire crop.

To address the problem of infestation by rice bugs, local farmers have employed five practices:

- synchrony in planting (all local farmers plant rice crops at the same time and reduce an individual farmer's risk by spreading the risk over a larger area)
- conventional insect control (farmers use this practice as insurance against unacceptable levels of crop loss)
- the blowing of smoke over the rice field (largely ineffective)
- the use of nets to catch rice bugs (largely ineffective), and
- the spraying of neem oil (largely ineffective).

One experiment: two objectives, four treatments

IRRI scientists are working with local farmers, extension agents, and researchers in Laos to implement an experiment that has two main objectives:

- determine which of four treatments is most effective for controlling rice bugs.
- enable farmers to compare treatments.

At the beginning of the 2002 wet season (early June), researchers from Laos and the Philippines set up an experiment that divided rice fields into quadrants. Each quadrant has received a different treatment: no control at all, insect control only, weed control only, or a combination of insect control and weed control. Weed control treatments started in July 2002 when the plants began to bud. Insect control treatments will start in August or September 2002. Only farmers already using insecticides to control rice bugs will take part in this experiment; their participation will reduce insecticide use by 50% in their fields.

Experimental design is one example of cooperation and linkage among farmers, extension agents, and researchers. For instance, when IRRI researchers began to develop the experiment for comparing different treatments, discussions between national staff and international specialists led to a revision of the originally proposed protocol so that the experiment would be more relevant to the needs of Lao farmers. That local researchers are in a position to offer this vital input is evidence of successful capacity building in Laos.

The original design would have placed several cages in a field, applied only one treatment (insect control), gathered three sets of data (yield in treated areas, yield in untreated areas, yield without insect damage), and compared the effectiveness of treatment versus no treatment. With their extensive knowledge of local conditions, Lao researchers suggested modifications to that design because it was not a real world setup. (Real fields have no cages in them.) Together the researchers devised a quadrant design that would test several treatments side by side in one field, make it easier for researchers to control for variables (location, climate, rainfall, and other factors), and allow farmers to compare the effects of each treatment in their fields.

Putting together the pieces of the rice bug puzzle will take some time, but the complete picture promises to be a more harmonious one for all inhabitants of the rice ecosystem.

A. Barrion

Cataloging of insects has been a major component of rice bug ecosystem studies in Laos. In the process, scientists have discovered insect species that had not previously been identified. What interaction, if any, do these insects have to the rice bug? Rice researchers seek the answer to this question.
Top (left to right) Adult male of *Nilaparvata*; Leg showing tibial spur and spines; and male genitalia.
Bottom (left to right) Adult male of *Zyginidia*; Head and thorax; and ventral tip of abdomen.

A rice crop becomes predisposed to an infestation by rice bugs when any of four conditions apply:

- crop is between the pre-flowering spikelet emergence stage and the soft dough stage (grain formation);
- crop is out of synch with other rice crops, especially if it is late-maturing;
- all rice crops are at the same stage when rice bugs are flying around; or
- crop is close to a forest.

Susceptibility also depends on the time of year that a particular farmer plants rice.

The calm after the onslaught of rice bugs: water and a farmer's hopes for a better cropping season prepare this field for the next rice-growing season.

No treatment	Insect control
Weed control	Insect control Weed control

Replication = minimum of six fields per village

This diagram shows a field divided into quadrants. Each quadrant receives a different treatment. Among quadrants, researchers will measure and compare yield, rice bug damage, and percentage of unfilled grains.

The future

sustained partnerships for sustainable rice production

In part, the quest for long-term sustainability in rice production for Laos has been possible because of the steady role that the Swiss government has played as a major donor in Laos. Such unwavering support can never be taken for granted, and so the people who engage in this quest are seeking additional sources of funding for this significant work.

Interorganizational partnerships build capacity, promote sustainability

Financial support is an important example of collaboration between organizations. For more than a decade national government policy, including partnerships between the government and outside organizations, has done much to build capacity and promote sustainable rice farming practices within Laos:

- 120 National Agriculture and Forestry Research Institute (NAFRI) staff have been highly trained in rice research and production.
- 400,000 subsistence rice farmers in Laos have access to improved rice varieties and are familiar with improved rice farming practices.
- About 5 million rice consumers in Laos have an abundant supply of rice that is as affordable as in neighboring Thailand and Vietnam.
- The number of households that practice slash-and-burn agriculture has decreased significantly. In 1990, 150,000 households practiced slash-and-burn agriculture; in 2001, only 50,000 households still used this practice. The Lao government aims to phase out slash-and-burn completely by 2005.

Much still remains to be done. Laos continues to have a great need for training and educational opportunities. "Telecommunications capabilities need to be improved so that people in government can get e-mail and Lao students who have studied outside of Laos can maintain links with their international colleagues when they return to Laos," says Dr. John Schiller, former team leader and research programmer of the Lao-IRRI Project.

Greater attention to interorganizational communication at the country-to-country level also promises to enhance the ties that Laos has with Cambodia, China, India, Thailand, and Vietnam. Already these links have increased the number of opportunities for collaboration between large programs and small programs. The NARES link between Laos and Thailand, for instance, is so well developed that it provides resources to several countries: Laos, its neighbors Cambodia and China, and India.

Mr. Karl Goeppert (standing and inset), IRRI representative to Laos and team leader of the Lao-IRRI Project, addresses students in a Basic English course at the National Agricultural Research Center (NARC) near Vientiane.

J. Gorsuch

J. Gorsuch

(right) Mr. Koang Douangsila, head of the national rice research program, visits experimental plots at the National Agricultural Research Center (NARC).

Increased use of irrigation boosts rice production

In addition to the challenges posed by communication and finance, scientists in Laos and at IRRI face the technical challenge of working within marginal environments in a different way than they have previously. That role must change to reflect a modification of farming practices.

For instance, rice production in non-irrigated (rainfed) environments has declined significantly in the past decade. In 1990, 90% of production in Laos was in a low-lying, rainfed environment. Through the sharing of information in consortia for NARES personnel, Laos has increased the use of irrigation schemes in order to steadily increase rice production every year. As a result, by 2001 irrigated rice accounted for 18% of national rice production, lowland rainfed rice 70%, and upland rice 12%.

Intensified use of irrigation has boosted rice production significantly. In 2001 Laos produced 300,000 tons more rice than in the previous year, and was self-sufficient in rice production for the third successive year. However, this figure masks regional deficiencies in production which, if addressed, would boost food security for the whole country. Areas near the border with China and Vietnam still lack a sufficient supply of rice for three to five months per year. To supply these regions with rice, it is cheaper for the government to import rice from neighboring countries and export rice from regions of Laos that have a surplus.

As the areas with rice deficiencies increase their production of rice, the nature of trade will change. "As the lowlands reach their productivity potential, Laos will need to export its excess production," says Dr. Linquist. In addition, the Lao government seeks markets for glutinous rice, which comprises 85% of national production and for which production surpasses that of other countries. Also, farmers seek opportunities for crop diversification. The irrigated environment offers the most prospects for diversification: farmers can now grow vegetable crops during the dry season.

Rice research collaborators continually test new ideas

Rice research never stops and new ideas continuously emerge. During the 2002 rice-growing season, for instance, the national rice research system is conducting a first-time, 10-site test of a practice called System of Rice Intensification (SRI). SRI advocates drastic changes:

- Early transplanting with seedlings that are only two weeks old
- Only one plant per hill (hole into which seedling is transplanted)
- Use of much less water than is conventionally used by farmers
- Greater spacing between hills

Furthermore the SRI project is evaluating the yield potential of 70 black rice varieties. These activities provide opportunities for bachelors degree students at Lao National University to simultaneously learn about and create new rice farming technologies.

Interorganizational sharing of information and resources has facilitated these efforts. With more and stronger connections to partner organizations, the threads of information that form the fabric of rice research can be woven ever more closely, making an enduring pattern for the next generation of rice growers and consumers.

Bounmy

(left to right) Mr. Kouang Douangsila (director, National Rice Research Program), Mr. Soulivanthong Kingkeo (deputy director, National Agriculture and Forestry Research Institute [NAFRI]), and Mr. Phoumi Inthapanya (director, National Agricultural Research Center [NARC]) field comments and questions about their vision for rice farming in Laos at the Annual Planning Meeting in 2002.

Lao-IRRI Project activities are compatible with the missions of these national research programs. Despite being a single-crop project, LIRRTP takes a holistic view of the farming system and encourages farmers to experiment with maize, potatoes, trees, and cash crops such as coffee.

ACIAR: example of an institution that has forged important links between organizations, individuals

In partnership with the NARES within Laos, organizations outside of Laos provide key resources. The Australian Centre for International Agricultural Research (ACIAR) stands out as a key partner for agricultural research in Laos. The most lasting and effective collaborations with the Lao National Rice Research Program and Lao-IRRI Project have been a number of projects supported by ACIAR. These projects have done much to build institutional capacity within Laos.

"I had a link with ACIAR-supported projects while I was working with the Department of Agriculture in Thailand, prior to moving to Laos," says Dr. John Schiller. "Subsequently, ACIAR provided support for research and training in Laos." These projects received funding from ACIAR, and people in the implementing agencies effected the projects.

The University of Queensland, the University of New England, and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Wildlife and Ecology were particularly active as implementing agencies. Staff from these agencies spent a lot of time and effort in training, both within Laos and by taking Lao staff into their respective institutions for periods of time. This training continues today.

Another valued input through these collaborative projects was the opportunity for Lao scientists to interact with colleagues from other countries in the region, who were working on similar problems. Most ACIAR-supported projects have involved several countries and have provided regular workshops by country as well as by region or project. ACIAR has also provided support for in-country scientific writing courses. "Those courses have been very effective and appreciated," comments Dr. Schiller.

The human aspect of these activities has forged one of the most important linkages of all: the one between individual researchers. According to Dr. Schiller, the opportunity for interaction with other scientists in the region has been one of the most valued aspects of IRRI consortia activities.

The Swiss Agency for Development and Cooperation (SDC) the donor organization that has funded the Lao-IRRI Project, is part of the Federal Department of Foreign Affairs. International development cooperation and humanitarian aid are instruments of Swiss foreign policy.

SDC's vision. Democracy and market economics seem to be increasingly accepted as basic principles of social organization. Poor countries and disadvantaged people are being confronted with new risks, but also with new opportunities. International cooperation seeks to address issues such as globalization, resource management, ethnic and religious tensions, the growing gulf between rich and poor, and migration.

SDC's mandate includes the following priorities:

- Poverty alleviation
- Ensuring sustainability
- Aiding victims, resolving conflict, and ensuring peace
- Empowering the disadvantaged
- Providing access to information
- Ensuring equitable development for women and men
- Fostering understanding between cultures
- Supporting human rights, the rule of law, and democracy
- Improving living conditions
- Protecting lives and aiding victims
- Shaping Swiss foreign policy

SDC's partnerships. Responsibility for development and transformation lies with our partners. SDC supports them in exercising this responsibility. Constructive and equitable partnership is the starting point for sustainable cooperation. SDC works with partners who are willing to cooperate in a spirit of responsibility, openness, and efficiency, in order to achieve common long-term aims:

- Developing alliances with the poor and the disadvantaged
- Working with effective and credible partners
- Linking up with the forces of change
- Cultivating diversity in partnerships
- Committing to multilateral cooperation
- Building strategic alliances in Switzerland

For more information about SDC, visit
http://194.230.65.134/dezaweb2/root/Publications/Bilaterale_Entwicklungszusammenarbeit/E_Default.asp

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ISBN 971-22-0178-3