Old Ways Restored after 'Experts' Fail

Bali, Indonesia. On a sultry afternoon, in a small village surrounded by coconut palms and terraces of emerald green rice, several people with diverse backgrounds took off their shoes and sat cross-legged in an open pavilion for an auspicious event.

For three hours they talked. On one side sat the farmers of the Umelawas Subak, a rice-growing organization whose rice crops were plagued by viruses and insects. On the side other sat Indonesian government agricultural officials. In the middle sat anthropologist Stephen Lansing.

Lansing had come to help the Balinese farmers reclaim an ancient growing tradition that had been dismissed by Western agricultural scientists as a "rice cult" and, therefore, abandoned.

For at least a thousand years, farmers in Bali, one of 13,000 islands in the Indonesian archipelago, had harvested rice from a complex, engineered terraced system, producing several tons per acre, year after year, without causing the ecology to deteriorate.

But when, early in the 1970s, Indonesia found itself hard put to grow enough rice to keep up with its burgeoning population, now the fourth largest in the world, it eagerly adopted the technology of the Green Revolution: switching to strains of short-cycle hybrid rice that required fertilizers and pesticides for their prodigious yields. The technology prevented severe famine in India, and later in South America and Southeast Asia.

Agricultural specialists were called in from the West to change growing practices. In Bali, the provincial government required farmers to abandon their "rice cult" of coordinated planting and irrigation schedules and to plant fast-maturing rice as often as they could. Fertilizers and chemical pesticides were sold at subsidized prices.

Soon, district agricultural offices were reporting "chaos in the water-scheduling system" and "explosions of pest populations." By the mid-1970s, the paddies of Bali were being infested by one pest after another, both insects and viruses. Rice production plummeted. Agricultural specialists responded by developing still newer strains of pest-resistant rice, only to see the new strains succumb to different viruses or insects.

At that time, Lansing, Chairman of the University of Southern California's Anthropology Department was studying the historical evolution of the island's temples. They are part of Bali's Hindu religion, which in many ways bear little resemblance to the type of Hinduism practiced in India. The farmers he interviewed, worried about their rice problems, were more interested in talking about how their temples had once set a complicated rotational irrigation schedule for the paddies.

In the new farming policy, the temples had lost control of the irrigation schedule, and now the crops were failing.

Although Bali's farmers had known for centuries how the rice-growing system worked, it was not understood by the outside world or by Bali's own agricultural bureaucracy. With a National Science Foundation grant, Lansing delved into it, eventually working with researchers from Udayana University.

The island's rice paddies are organized into cooperative farmers' associations called subaks, each of which may include hundreds of acres. A single watershed may hold dozens of subaks. The system is tied together by rituals centering around rice temples and managed by priests at the Temple of the Crater Lake at volcanic Mt. Batur, the source of the irrigation water.

The key to its success had evolved over centuries: the need for water and the need to eliminate pests are intricately balanced in a system of planting and leaving fallow that needs no fertilizers or chemicals.

Farmers coordinate the release of water from rivers to groups of subaks through a system of weirs that diverts it into tunnels. Priests sustain the rituals that make this possible. After a paddy is flooded and planted, the growing rice becomes a source of food and a breeding ground for pests. If crops are planted quickly one after another, pests may multiply out of control and devour the entire crop. To avert that, farmers incorporate fallow cycles throughout the subaks in each watershed, so that pests die off from a lack of food.

The fallow times also are part of the cycle of natural fertilization. After the rice is cut, stalks are left to disintegrate. Ducks are herded into the flooded paddies to eat insects and fertilize the soil. Blue-green algae bloom and fix nitrogen. When the pests have died, a new planting cycle begins.

Lansing tried to explain the importance of the rice temples to the Asian Development Bank, which had launched a major engineering project that included a new irrigation schedule to match the short-growing cycles of the new strains of rice. They paid little attention. It was not until he teamed up with James Kremer, a University of Southern California ecologist, that they began to listen.

As Lansing related in a book, "Priests and Programmers," he and Kremer developed a computer model to bring about an optimum balance between controlling pests and supplying water.

The problem was this: if all farmers plant at the same time and let their fields go fallow at the same time, the pest infestation decreases, but the demand for water overwhelms the supply, especially during the dry season. However, if they plant their crops at staggered times they may have enough water but are overwhelmed by pests.

Lansing and Kremer used the computer model to analyze seven management systems of 172 subaks in 12 catchment basins in a watershed of two rivers. The systems ranged from having all follow the same cropping pattern, to having each of the 172 follow a different schedule.

The model calculated the harvest for 172 subaks by calculating rainfall and runoff by season and elevation, growth patterns of different types of rice and the population dynamics of pests. The model clearly showed that when all subaks in a watershed plant and harvest independently, pest infestation eventually destroys up to 100 per cent of the crop.

And, of all the possibilities, it turned out that the rice temples' management system was the most efficient.

The model also demonstrated that the procedures imposed by the outside agricultural specialists were doomed. Whether the crop was traditional long-cycle Bali rice or the shorter Green Revolution rice, the temple system combined the highest yields with the fewest pests and the most optimal use of water.

Today, the Bank has admitted its error. The rice temple system, whose colorful ceremonies were never abandoned by farmers although the planting cycles were, is being renewed.

Now, with the help of Apple Computer programmers, Tyde Richards and Alan Peterson, who donate their time and who persuaded Apple to donate some computers to the project, Lansing is working with Indonesia's agricultural officials on a project funded by the UN Food and Agricultural Organization. Their goal is to develop a version of the program to meld the rapidly growing rice varieties continually being developed by Green Revolution scientists into the old system. Peterson is revising the program for use by extension agents and farmers to use new varieties of rice throughout a watershed area.

The meeting at the Umelawas Subak was among the first to introduce the prototype.

Lansing hopes the computer program will eventually help farmers take advantage of the Green Revolution without harming the paddies' basic ecology. Green Revolution rice hybrids cannot be grown without chemicals, and farmers now apply the fertilizers indiscriminately in a system that has been self-fertilizing for centuries. The computer program will compare fertilizer use among regions to help Bali's agricultural agents analyze its effects on crop yield as well as the ecology, with the goal of reducing its use.

"The structure is still in place," said Lansing. "The ecosystem can continue to function as long as the chemical problems can be solved. This story could have a happy ending."

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