Coccinellid (ladybug family) eating a brown planthopper. When insecticides kill natural predators, the brown planthopper population can reach 1,000 pests per clump of rice.

Disarming Farming's Chemical Warriors

Research brightens the dark underside of the green revolution

By CHRISTOPHER VAUGHAN

The year 1983 proved a landmark for the 168 million people of Indonesia. For the first time in modern history, Earth's fifth most populous country, once the world's largest rice importer, succeeded in growing enough rice to feed itself. It accomplished this by pursuing what one expert calls "intensive farming beyond the comprehension of most American farmers."

Yet within the historic feat lay the seeds of serious future problems.

Much of the Indonesian archipelago's 13,677 islands is covered with an emerald-colored patchwork of rice paddies. As part of the "green revolution," the government introduced modern fertilizers, new rice strains and an intricate irrigation system that can control water levels to within an inch, allowing rice farmers in Indonesia to harvest two or three high-yield crops a year.

By 1985, however, this progress was threatened by the notorious *wereng,* or brown planthopper, which causes rice to dry out, rot and fall in the field. The government, and especially the rice farmers, remembered well the disastrous harvests of 1975 to 1979, when the tiny pest laid waste to 10 million acres of rice — a devastating loss for a country of small farms, where a half acre often must support a family of five.

To prevent the hotspots of brown planthopper infestation from spreading, the government of Indonesia invited the United Nations' Food and Agriculture Organization (FAO) to initiate an ambitious project called integrated pest management, a program started in the Philippines and now being implemented in many countries throughout South and Southeast Asia. Ultimately, integrated pest management could provide the 45 percent of the world's population that lives in South and Southeast Asia with rice-growing techniques that could save developing countries millions of dollars and preserve wildlife and human health without endangering high crop yields.

Integrated pest management teaches farmers to spray very little insecticide on their crop, allowing the field's natural insects to battle it out among themselves whenever the farmer determines that rice-eating insects are at a disadvantage against their predators. The scientific basis for using the technique in Indonesia lay in research done after the 1975-1979 brown planthopper disaster. Scientists found that one of the high-yield farming techniques begun during the green revolution had a dark underside: The pesticides introduced and subsidized by the government to increase yields killed some of the brown planthoppers, but they also killed many beneficial insects that preyed on the planthoppers.

Researchers found that farmers were often spraying their fields habitually — regardless of whether the fields were infested — and that such overuse of pesticides actually increased the risk and severity of pest infestation in the rice fields. This and other research indicated Indonesia's need for integrated pest management.

"If left alone, the good insects — predators — usually would keep pace with the bad ones and preserve the crop," says FAO Program Coordinator Peter Kenmore. For instance, one wolf spider can eat five to 20 brown planthoppers a day, he says.

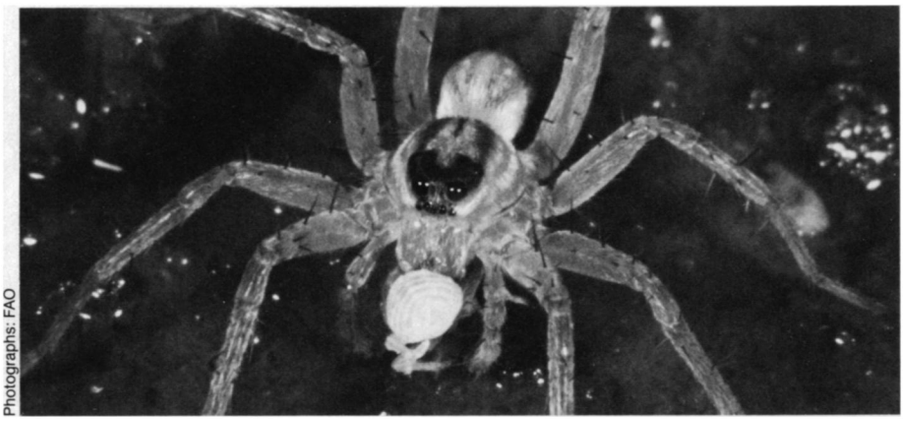
But planning a program of integrated pest management was far easier than instituting it among Indonesia's 2.5 million farmers. Many farmers saw the use of pesticides as insurance against the threat of infestation, and with the government subsidizing 75 percent of the cost of pesticides, they often saw little reason to change their farming methods, says Allan Steinhauer, chairman of the entomology department at the University of Maryland in College Park and executive director of the Consortium for International Crop Protection. "You can do everything bureaucratically and politically, but if you can't get the farmers to change you're

dead," Steinhauer says. "It takes almost a catastrophe to do that."

Nevertheless, Indonesian officials were convinced they almost had a catastrophe, and the government and the FAO embarked in 1986 on a crash program to educate farmers about integrated pest management and the dangers of pesticide use. "What we tried to do is replace a chemically based farming technique with a knowledge-based technique," Kenmore says. By going out into the rice paddies, the trainers showed farmers how to diagnose problems, calculate the ratio of good bugs to bad and decide how much damage the crop could take without harming the yield. "For instance, we showed them that the plants can lose half their leaves in the first month of growth without harming the yield, but only 10 percent of the leaves later on," Kenmore says.

A pilot project in early 1986 sent integrated pest management experts into the field to train 1,600 farmers and 300 extension workers. FAO scientists intensively followed a representative sample of farmers from key provinces in Java and North Sumatra, which produce more than 70 percent of Indonesia's rice. Untrained farmers applied insecticides 4.5 times in a season, while farmers using integrated pest management techniques grew crops with 1.9 applications.

A brown planthopper outbreak ravages rice plants. Brown plants in background already have succumbed to the infestation. Below left: Wolf spider preys on a brown planthopper. Wolf spiders are voracious eaters, consuming five to 20 brown planthoppers every day and more than 1,000 over a lifetime.



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A review of the first season's results showed integrated pest management worked as well in the field as it had in the laboratory. Those farmers using normal practices produced 2.47 tons of rice per acre compared with the newly trained farmers' yields of 2.55 tons per acre. And despite the high subsidies for insecticides, the farms cultivated with the new techniques proved more profitable than those sprayed more often, because the farmers weren't spending as much on insecticides.

The results of the pilot program convinced the Indonesian government to declare in late 1986 that integrated pest management would be the national pest control strategy for rice. In order to protect predator insects, the government also banned 56 of 57 pesticides previously approved for farming in Indonesia. The one pesticide left available to farmers attacks only the brown planthopper.

The government is now tackling the job of giving all of Indonesia's 2.5 million rice farmers 30 hours of training in integrated pest management by 1994. In June of this year, after the third crop season in the program, Indonesia proclaimed the program a success so far. Seven thousand farmers have been trained and 20,000 more have been exposed to the technique. The trained farmers apply one-ninth as much pesticide as they did before training, with no decrease – and sometimes a slight increase – in crop yield.

Now that the farmers understand that integrated pest management won't cause their yields to fall, they are quick to see the program's benefits, Kenmore says. Even without high government subsidies for pesticides, the cost of spraying the crop has dropped from $2.50 per acre to $1.00 per acre, and farmers have learned how to diagnose problems in their fields better, he adds.

"I've had farmers show me a brown patch that they would have sprayed with pesticides before, but they now know the problem to be nutritional," Kenmore says. "Then they show me another brown patch that they now know is not caused by pests but by fungus."

The government has benefited by saving much of the $120 million spent every year on pesticide subsidies, and Indonesia's streams and wildlife are beginning to be spared the ravages of rampant pesticide use. Thailand, Bangladesh, Sri Lanka, Malaysia and India have instituted similar programs, and China has asked the FAO to start an integrated pest management program in that country, Kenmore says.

Only one source of dissatisfaction remains among Indonesia's farmers, Kenmore says. "They are demanding integrated pest management for their other crops and asking why we don't have a system for beans or cabbage," he says. "I tell them it will just take more research."□