Gerardo Sota farms on some of the most difficult terrain on earth -- the precipitous slopes of the Andes mountains in Colombia. No farm machine can negotiate the steep hillsides and narrow furrows. Every carefully terraced row must be plowed by hand. Every bean pod, ear of corn, or potato that grows is picked or dug by hand. He, his sons, and now his grandsons work year-round to keep their hectare-and-a-half farm productive.

Despite the demanding conditions for farming, Sota loves his land. To him, every square metre is precious and, if treated well, will give something back. "Agriculture is my profession," Sota explains. "My father taught me how to farm the land. Farming is what I most like doing."

Staple Food

Sota grows potatoes, carrots, corn, and -- most importantly -- beans. Beans are a vital food crop in the Andean region of South America. In Colombia, Ecuador, and Peru, beans provide both calories and protein in the diets of the rural poor. Many Andean families eat beans three times a day. By the turn of the century, demand is expected to exceed supply by 30%. Beans have been grown in rotation with corn on the mountain slopes for thousands of years. The stalks left from the harvested corn form climbing poles for the beans. The nodules on the bean roots take nitrogen from the air to fertilize the soil for the next corn crop.

Gerardo Sota had always farmed without using chemical pesticides. More than 20 years ago, his father had warned him of their dangers. For years, he saw no need for them. But 15 years ago, the situation changed. "I started to use them ever since I lost a bean crop," he recalls. "The crop was attacked by a pest. The
beans had already developed pods and suddenly that pest attacked. The pods turned black."

**Vicious Cycle**

Sota lost his crop and any chance of making ends meet that year. He determined never to let it happen again, deciding that the risk of sickness from the insect spray was worth it. Now Sota and the other bean farmers of the Andean region are caught in a vicious cycle of ever increasing pesticide use.

The indiscriminate use of the sprays killed not only the pests but beneficial insects too. As a result, what had been insignificant pests, such as the leafminer, were left with no natural enemies and began devastating bean crops. So farmers had to spray more. Today, in some bean-growing areas of the Andes farmers spray every week.

"We farmers have a fault," explains Sota. "If we see that a tablespoonful works to kill the insects, then we say, 'Well let's add another tablespoonful so it will be even more effective!'"

**Cause for Alarm**

Practices such as these were alarming Dr Cesar Cardona, an entomologist at CIAT, the International Centre for Tropical Agriculture based in Cali, Colombia. "We detected a very serious situation of insecticide abuse among small bean farmers in the Andes of Colombia, Ecuador, and Peru. We found that the levels are extremely high, that the crop is becoming uneconomic because of the excessive use of chemicals," Cardona says.

In the past, Cardona himself had advocated the use of pesticides to improve crop yields. "I was trained to use pesticides 20 or 25 years ago. I did it for a while but I have been convinced that we can produce safer products at lower cost without using so many chemicals."

**Participatory Research**

Cardona determined that a program of integrated pest management, a strategy that had worked with many other crops to reduce the need for spraying, could work on the tiny mountainside plots if enough farmers could be convinced to use it. The key to his idea was to involve farmers in the research itself.

With funding from IDRC and the cooperation of the national agricultural research systems of Colombia, Ecuador, and Peru, Dr Cardona initiated a program of farmer participatory research to find out which insect management strategies would work.

**Implementing IPM**

The whole goal of integrated pest management (IPM) is to reduce pesticide use to the minimum necessary by introducing practices such as destroying crop residues that harbour the eggs of next season's pests. The crops are regularly inspected and then sprayed using only the chemical that is appropriate for the particular pest. The various components of the IPM approach had worked well in other situations but this was the first time anyone had tried to use them with small farmers in such difficult terrain and with a crop like beans.

Cardona's research team selected farmers willing to set aside some of their fields for the tests. Each farmer had two similar plots -- one which he or she maintained in the usual way, spraying whenever it was considered necessary. In the adjacent plot, the scientific teams used the more environmentally sound, integrated approach.

If IPM techniques worked, the scientists thought the farmers participating in the tests would see the results
right away. For the most part that was true. But the researchers also learned from the farmers. Not all the ideas tested at the research stations were acceptable to the farmers. For example, the scientists thought that sticky yellow traps coated with fuel oil would reduce the insect population. To trained scientific eyes they did kill millions of bugs. But the scientists had not considered the extra work involved in maintaining the traps on the steep mountain slopes. The extra trips down the mountain to town to get new oil, and the cleaning of the traps demanded too much labour to be worthwhile. Moreover, although the traps were full of dead bugs, the farmers still saw thousands of live insects on their bean plants.

Simple Monitoring Techniques

Another part of the IPM strategy is to monitor the bean plants for signs of insect infestation. But many of the farmers have little formal education. The careful record keeping and arithmetic that served well at the research stations could not succeed with the farmers. So the researchers who were working with farmers on the test plots in Ecuador came up with a straightforward monitoring and counting technique that every farmer could understand and use. It required just a glass jam jar and a pocketful of beans. For every damaged bean pod the farmer spots, a bean goes into the jar. If the jar fills slowly, there is no need to spray.

Cesar Cardona says the results on the test farms throughout the region are impressive. Crop quality has been maintained, pesticide use dramatically reduced and the profitability of the bean crop increased because the farmers spend less on pesticides.

"If most of them start implementing IPM, insect population levels will gradually decrease in the area," Cardona says. "Now they do see the better economic returns and lower cost. There is no need to use so many chemicals. They can produce the same with at least 60 or 70% less insecticides without losing a penny -- or even make more money."

Everybody Wins

In the towns and on the farms of the Andes, it is an approach by which everybody wins. Consumers get a healthier product, farmers expose themselves and their families to far fewer potentially damaging chemicals, and the land carries a lower toxic burden into the future. Eventually, it appears possible to restore the equilibrium that existed thousands of years ago when the indigenous people of the region first understood the close relationship between beans and corn and never used a drop of insect spray.

The next phase of the project will develop methods of getting the technology from the test farms to everybody's farm. Gerardo Sota does not think this technology transfer will be especially difficult. "It favours farmers and it's less risky for us not to use toxic chemicals. Consumers are in less danger of being harmed by these products. I would recommend it because it gives such good results."

David Mowbray is an Ottawa-based film-maker and writer, reporting from Colombia.

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The CIAT-Canada Connection
Canada has had strong links with CIAT, the International Centre for Tropical Agriculture based in Cali, Colombia for a quarter of a century. CIAT is one of 16 international research centres in the developing world devoted to improving food security for the world's most impoverished people. It was founded in 1967 and since 1971 both the Canadian International Development Agency and IDRC have been major donors to the operations and the research programs of the renowned Centre.

Robbin Ruggles, a Canadian recently on CIAT's professional staff, points out that Canada was instrumental right from the beginning in getting CIAT's renowned cassava improvement program off the ground. Cassava, a root crop that originated in South America, now serves as a food staple for half a billion people, primarily in South America and Africa.

**Canadians Benefit**

Canadians farmers have also benefitted directly from work done at CIAT. In addition to its research work to improve beans, cassava and other crops, CIAT holds one of the world's major germplasm collections in its gene bank. A navy bean variety called ExRico 23 was developed by the national research program of Colombia. CIAT introduced it to North American farmers. It is resistant to white mould disease and its use has saved Canadian farmers millions of dollars. Other CIAT bean lines with resistance to potato leaf hoppers will soon find their way onto Canadian farms.

As for the future Ruggles feels there are areas for cooperation between Canada and CIAT that remain to be tapped. He would like to see CIAT linked with more agriculture and environment departments at Canadian universities. "CIAT can act as a bridge for Canadian universities to partner with national organizations in developing countries."

**Links to explore ...**

Related IDRC articles and publications

- [In the Tangerine Grove: Pesticide Use in Thailand](#), by Daniel Girard. A multidisciplinary research team examines the high incidence of pesticide poisoning and damage to humans and the environment in Thailand.

- [Return to Resistance: Breeding Crops to Reduce Pesticide Dependence](#) Raoul Robinson describes how to use a long-neglected plant breeding technique to create hardy new plant varieties that are naturally resistant to pests and disease.

- [Women and Integrated Pest Management](#), by Margarita T. Logarta. Researchers in the Phillipines have been introducing a new system of integrated pest management to rural women.

Additional resources:

- [Cooperative Research Centre for Tropical Pest Management Internet site](#)

- [IPM Net Internet site](#) Information for international agricultural interests from the Consortium for International Crop Protection.

- [Selected references on pesticides and pest management](#)

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In the Tangerine Grove

by Daniel Girard in Thailand

In 10 years as tangerine growers in a province about 40 kilometres north of the Thai capital, Krua Pophan, her husband and their two teenage children have been repeatedly poisoned by the pesticides they use. And through the spraying techniques she employs, Krua has developed a constant case of conjunctivitis, more commonly known as pink eye.

Despite the recurring sickness, Krua said she and other tangerine growers in the region have never been visited by government or pesticide industry officials to be instructed in the safe use of the products essential to their business. "People only promote pesticides," Krua said in an interview. "They don't care about the illnesses and the deaths. Of course we would like advice. Who wouldn't? There are lots of people getting sick."

Indeed, there are about 7,000 pesticide poisoning cases reported in Thailand each year, said Palarp Sinhaseni, a toxicologist at Chulalongkorn University in Bangkok. About half the cases result from occupational exposure, of which few people die. The remainder are suicidal, which carry a higher death rate, she said.

Tangerine farming, which requires spraying pesticides at head level and above, is consistently in the top five categories of poisoning cases across Thailand, Palarp said. These statistics are just part of the story. Tangerines are widely consumed in the country -- without any removal of chemicals -- and the crops are sprayed from boats in irrigation canals, leading to frequent contamination of water used by households downstream. For Palarp, these factors make the crop a good choice for an IDRC-sponsored project to devise a training program to educate workers, government officials and pesticide industry personnel on the safe use of chemicals.

The central question in the multidisciplinary project is why pesticide poisoning is so much more prevalent in developing countries than in the West, Palarp said. Therefore, the team from Chulalongkorn, including specialists in communications, curriculum development and education, socio-psychology, agricultural extension and toxicology, are trying to address such matters as how exposure can be reduced, why farmers do not follow advice they are given and how well government agriculture workers communicate with tangerine growers.

SAFETY NOT A PRIORITY

Research to this point shows that government agriculture workers in Thailand have typically focused their work with farmers on maximizing crop yields rather than the safe use of pesticides. And, as Krua pointed out, tangerine growers are rarely visited by the authorities. Palarp said the government workers are beginning to realize that overusing chemicals creates pesticide resistance and ultimately reduces crop yield. They are trying to use less, she said.
Project surveys show that the tangerine farmers want to protect themselves against pesticides and reduce their exposure to chemicals but lack the knowledge of how to accomplish that, Palarp said. She cited the example of Krua's children wearing sponge masks for protection while spraying. The devices actually led to poisoning because they soaked up the pesticides, bringing them in greater contact with the teenagers' mouths.

"You have to teach them not just what to do but how to do it," Palarp said. "In order for farmers to practice safe pesticide use, the government and industry have to provide them with the necessary tools."

Palarp, the project leader, said the research team is also pushing to limit access in Thailand to highly hazardous insecticides. They do not want the chemicals banned but instead, she said, they want to limit their use to experts wearing protective equipment. Currently, highly toxic pesticides are widely available with no restrictions or government-regulated scheme, Palarp said. "We are lagging behind in our regulations," she said. "But we'll do better. We're accelerating our speed."

While occupational poisoning, which results from mixing, loading, spraying, spilling or contaminating clothes with pesticides, is a main focus of the research team's work, the group is also examining other forms of pesticide contamination.

ENVIRONMENTAL DAMAGE

The other main problems are environmental, Palarp said. After spraying, the chemicals stay in the soil, get into the groundwater and lead to contamination through drinking and bathing, she said. They also damage air quality since the insecticides drift in the wind, Palarp added. Further environmental contamination results when produce grown between rows of sprayed crops absorbs the insecticides, she noted.

Another major research concern is the disposal of pesticide wastes. After spraying, the equipment is washed, spreading chemicals into the irrigation canals and then the water supply. Also, Palarp added, farmers often burn contaminated packaging and equipment, increasing the amount of pesticides in the air. In her view, a more environmentally friendly and affordable solution would be using a 5,000-baht (US$200) furnace that burns at such a high temperature that all the toxic elements are eliminated.

The sale by farmers of used, contaminated pesticide containers to middlemen who employ people to clean the containers also increases the potential for insecticide poisoning, Palarp said. Under the current Thai system, the cost of pesticide poisoning is paid by the public in the form of contaminated water supplies and foods and the high number of sick workers, Palarp noted. Multinational companies, which sell millions of dollars a year worth of insecticides, need to be pushed harder to pay for their share of the problem, she said.

TOUGHER LAWS

But ever since a massive chemical fire at a Bangkok port in 1991, the government has been trying to address the problem of hazardous substances, Palarp said. An act was passed putting tighter restrictions on chemicals. Since then both legislators and industry have been paying more attention to the issue, she added. According to Palarp, industry is being forced to pay closer attention to its packaging practices to try to reduce the amount of waste produced.

And in a country where 60 to 70% of its 55 million people are farmers, it is obvious that there is a tremendous need for a program to teach people how to use pesticides safely and provide them with the correct protective equipment. At present, there are no Thai-specific guidelines for pesticides, so the country refers to those set by the United Nations Food and Agriculture Organization. But tropical countries are more sensitive to pesticide poisoning; for example, the many and varied species of fish, an important protein source for many people in this region, have been killed in large numbers or otherwise made unfit for human consumption. This consideration makes the need for safe local practices all the more pressing, Palarp said.
Another important aspect of the project, Palarp noted, is to strengthen the system for recording pesticide poisonings. Currently, if a farmer goes into a hospital for sickness, he or she is treated but there is no monitoring of the illness, its circumstances or the chemicals involved. If that data were compiled, authorities would be better able to determine which chemicals are hazardous and develop a program to train government agriculture workers and farmers in their safe use, Palarp said.

While it focuses on one crop in one country, the tangerine pesticide safe use training program, slated to be ready by the end of 1994, will be about 60 to 70% applicable to different forms of agriculture in Thailand and other Southeast Asian countries, Palarp said. "Obviously the agricultural practices would be different in something like rice farming but communications, psychology and the impact of government agricultural workers would likely be very much the same," she said.

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WOMEN AGAINST CROP PESTS

INTEGRATED PEST MANAGEMENT IN THE PHILIPPINES

MARGARITA T. LOGARTA

ural women in the Philippines are slowly beginning to realize that they actually do 'hold up half the sky'. Studies indicate that women are vital participants in rice farming. Although they provide less than one-fifth of the actual labour needed for rice production, they have a major role in decision making on the farm. For example, besides running the farm household, bearing children, and augmenting the family income, they also make important decisions about the purchase of agrochemicals.

Integrated Pest Management (IPM) -- an environmentally and economically sound way to control agricultural pests (see box).

Under the project, Filipina researchers introduced IPM to five communities in Calamba, Laguna, 50 kilometres south of Manila. "At first, the men denied any participation of their wives in the farming process," observes Dr Candida B. Adalla, an entomologist working on the project. "But in further discussion, some revealed that the women were responsible for choosing and buying pesticides during their trips to market."

In Asia, four countries have adopted IPM as official policy on crop protection: the Philippines, Indonesia, India, and Malaysia. "Wide scale IPM adoption should reduce pesticide use on rice by 50 percent," according to Dr Shepard. That could save the Philippines about US$5 to 10 million per year, and Indonesia as much as $50 to $100 million.

"A beautiful ecological balance between prey and predators in rice ecosystems has evolved over centuries," said Dr Merle Shepard at a recent briefing in Washington for representatives of international agricultural research centres. Dr Shepard is former head of the entomology department of the International Rice Research Institute in Los Banos, Philippines. "Pesticide misuse upset that balance in many areas. But researchers hope to restore it through integrated pest management."

In Asia, four countries have adopted IPM as official policy on crop protection: the Philippines, Indonesia, India, and Malaysia. "Wide scale IPM adoption should reduce pesticide use on rice by 50 percent," according to Dr Shepard. That could save the Philippines about US$5 to 10 million per year, and Indonesia as much as $50 to $100 million. When the stage of the plant, the weather, and the pest are right to achieve significant control for the least cost. Like most technologies, IPM must be fine-tuned and adapted to specific locations.

In considering their results after the first year, the researchers agree the project is succeeding and should continue. "IPM practices began to greatly influence the farmers' way of thinking," says Dr Adalla. "If they didn't spray in the IPM plot, they wouldn't spray the non-IPM plot as well."

More than three-quarters of the rice farmers obtained higher yields in the IPM portion. If not for a series of bruising typhoons which struck the Philippines last October, IPM yields could have been even higher, say the researchers.

More IPM experiments are currently being conducted on the vegetable plots since last year's results proved inconclusive.

A much misunderstood technology, IPM was initially seen by people as risky. Cooperators were difficult to attract. "We were cynical about the project," Mereng Manzano, a woman rice farmer, admitted. "We had been the victims of too many government projects in the past. Researchers came and went without even telling us of the results of the experiments."

Alejandro Muya, a school teacher who also manages a farm, said, "We thought that any insect had to be eliminated. We didn't know that 'friendly insects' help destroy pests."

Project coordinators won over the farmers by promising to reimburse them for whatever differences in returns between the two plots. Aware of the people's fears, Dr Adalla and her colleagues quickly established their presence in the communities. "We worked with them in the fields, lecturing and demonstrating IPM," she recalls. Their efforts paid off. "The people praised us for being ma-charisma (convincing)," she chuckles.

The staff employed various methods to bring the IPM message to the farmers and their families. They held regular meetings to share ideas and problems. Since few women attended the sessions because they were busy with household chores, the staff visited them at home to solicit their opinions.

The researchers also learned that the women were eager for new ways to earn extra income. Seminars in mushroom culture, accounting, and beekeeping were arranged. And now there are plans to organize a cooperative store stocked with basic goods such as soap, canned food, and coffee.

A team of communicators, headed by Dr Teresa M. Stuart, developed a four-week...
the curly-haired boy in his striped pajamas slept peacefully. What misfortune could have brought him to this hospital bed in Cairo? The shocking response was that this eight-year-old Egyptian had attempted suicide by poisoning. But he would survive, as would the two-year-old who arrived in her mother's arms a few moments later, the victim of an accidental ingestion of pills.

These children were among the lucky ones. They had been brought to the Cairo Poison Control Centre where a team of qualified clinical toxicologists works with limited resources to save lives. In this busy city of 12 million people, the centre has a herculean task to perform, but it has only 14 beds at its disposal. In 1988, it treated more than 3600 people for poisoning.

Six thousand kilometres to the southeast, in the Indian Ocean island nation of Sri Lanka, physicians grapple with the same problem. More than 25 000 poisoning cases two-thirds of them from pesticides and many of them attempted suicides are admitted to the country's state hospitals every year. Now the second leading cause of death in hospitals after heart disease, poisoning takes the lives of nearly 4000 Sri Lankans annually.

On the other side of the globe, staff of the Centro de Información y Asesoramiento Toxológico (CIAT) in Montevideo, Uruguay, worry about the growing problem of poisoning. The number of cases now numbers more than 6000 annually an alarming rate for a country of only three million people.

The rise in the incidence of poisoning in the developing world coincides with the increasing availability of pharmaceutical, industrial, and agricultural chemicals of both foreign and domestic origin. For countries whose economies are dominated by agriculture, poisonings are mainly the result of overuse and misuse of pesticides and fertilizers. In many instances, the daily users of such agrochemicals are illiterate and recording it with paper and pencil took up too much of their time. (Some farmers pleaded poor eyesight!) Thus, seven young boys, aged 12 to 15, were trained to do the job for peso (about 22 Canadian cents) an hour.

The regular radio program Balitang Pambuyot (Farm News) over station DZLB continues to provide supportive information and motivation for IPM cooperators and other clientele.

IPM activities were documented through pictures and video tape and exhibited at every opportunity. "It made the people feel good to see themselves on screen," says Dr. Stuart. Under her supervision, students of development communication designed an informative comic book, leaflets, and posters on IPM.

The staff hit upon the idea of creating IPM 'scouts' when many farmers complained that monitoring pest populations and recording it with paper and pencil took up too much of their time. (Some farmers pleaded poor eyesight!) Thus, seven young boys, aged 12 to 15, were trained to do the job for pesos (about 22 Canadian cents) an hour.

Puppets for IPM
Dr. Stuart's team also produced a puppet show on IPM entitled 'The Verdict', the story of a farmer who files a court case against insect pests. A one-day puppetry workshop was subsequently conducted for the scouts to groom them for future presentations.

When it comes to making agriculture a healthier and more profitable profession, it seems clear that women and youth can be successful agents of change, permanent change. Mereng Manzanero, a mother of two, is one whose life has been so touched. "IPM has truly been a big help to us," she says. "Even if Dr. Adalla and her group were to leave this place tomorrow, we would still continue to use IPM."

Margie Logarta is an investigative reporter with the Manila Chronicle in the Philippines.

**INFORMATION AS ANTIDOTE**

FRANCES DELANEY

**T**he war against poisoning in the developing world is an arduous one. Arming doctors and communities with the right information at the right moment helps save lives. In the long run it will also make for better informed communities generally thereby preventing poisonings from happening in the first place. Then, little children will sleep peacefully at home in their own beds rather than in hospital.

Frances Delaney is a senior program officer with the IDRC Information Sciences Division.
PESTICIDES AND PEST MANAGEMENT:
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