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Through the Roadblocks:
IPM and Central American Smallholders

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EXECUTIVE SUMMARY

Integrated pest management (IPM) is often promoted as one of the key elements of a sustainable approach to agriculture. IPM promises rational pesticide use, ecologically-based practices, better public health, and larger, sustained, harvests. However, in spite of several efforts, IPM has largely failed to take hold in Latin American farming.

This paper presents the authors' reflections on their experiences with promoting the use of IPM in the region. They suggest that the main obstacles to adoption include:

- Insufficient technical knowledge, with only a few IPM researchers with postgraduate degrees working full-time with smallholders, which limits the scope for IPM experimentation.
- A weak public sector, which limits the avenues for disseminating information about IPM.
- Inappropriate credit and subsidy schemes, which, for example, support agrochemicals rather than hand weeding.
- Influential agrochemical companies which stimulate demand for their products.
- Agroecosystem complexity, which requires context-specific technologies rather than blanket approaches.
- Language barriers between farmers, scientists, and extension agents.

Some of these obstacles, which limit research and development on IPM, can be mitigated. Often the most serious, yet most easily addressed, barriers are the attitudes and perceptions of IPM specialists. Their assumptions about the use of media, labour and capital supply, surveys, sampling, and the research agenda limit successful IPM adoption. Drawing on experience with encouraging and supporting farmers' own innovations, several practical and policy recommendations are put forward for ensuring IPM is adopted more widely in Central America.

- Avoid pedantic language in written extension materials. Note that talks can be just as effective.
- Place more focus on the threshold concept. Farmers will not adopt numerical sampling.
- Avoid surveys. Interact with farmers through research, extension, farmer workshops and scientist-aided farmer innovation.
- Don't assume that new technologies must always be cheap and labour intensive. It may be more effective to offer a menu of technologies, using different ratios of labour and capital and let the farmers choose.
- Avoid credit and subsidies for agrochemicals.
- Develop robust and/or site-specific technologies through farmer-scientist collaboration and investing in human capital.
- Encourage biological control, especially through supporting farmers' own experiments.
- Build extension programmes that inform farmers about the scientific basis of their problems, encouraging farmers to create.

THROUGH THE ROADBLOCKS: IPM AND CENTRAL AMERICAN SMALLHOLDERS

Jeffery Bentley & Keith Andrews

Introduction

Integrated pest management (IPM) has been listed as one of the keys to saving the planet (Peterson, 1991). IPM promises rational pesticide use, ecologically based practices, better public health and larger harvests (Bentley et al. 1995; Box 1). However, in spite of several efforts, IPM has largely failed to take hold in Latin American farming (Murray, 1994).

Although reluctant to adopt IPM, smallholders have eagerly adopted other agricultural innovations. For example, Honduran smallholders have rapidly adopted pesticides. They used almost no pesticides before 1975 (SECPLAN, 1989). Yet, by 1988-89, 178, 250 Honduran farms of under 3. 5 hectares (55% of the farms, but 8% of farmland) used $271, 250 worth of insecticides (9% of the nation's total), $79, 870 worth of fungicide (3% of Honduras' total) and $498, 115 worth of herbicides (8% of total) (SECPLAN, 1990). Smallholders used as much pesticide per hectare as larger farmers, except for fungicides, which are important in commercial banana production.

Besides pesticides, between 1975 and 1980 Honduran smallholders also rapidly adopted chemical fertiliser (SECPLAN, 1989) and modern crop varieties. In this process they have abandoned some traditional crop protection practices, including hand picking insects and using turkeys to eat insect pests (Martin, 1911). Smallholders are adopting soil conservation practices, including planting legume cover crops and not burning crop stubble (Bunch and López, 1995).

Thus, the poor uptake of IPM in the region cannot be attributed to the unwillingness of smallholders to adopt new practices. Smallholder uptake of IPM has been hindered by several obstacles, which can be likened to police roadblocks. If you misunderstand the rules of the game, the roadblock can be a serious delay. In this paper, we offer the reader the benefit of our mistakes in trying to encourage the use of IPM in Central America.

Obstacles to IPM

Low adoption of IPM is not due to the lack of IPM techniques. Central Americans have borrowed IPM concepts from the Northern countries since the 1960s. IPM specialists have developed agronomic, biological and pest sampling techniques to reduce pesticide use, including clearing weeds to control grasslooper (*Mocis latipes*) in maize, destroying crop

Box 1. Integrated Pest Management (IPM)

IPM focuses on six control areas:

1) *Cultural pest controls*: the manipulation of sowing and harvest dates to minimize damage; intercropping, vegetation management to enhance natural processes, crop rotations and tillage systems.

2) *Host plant resistance*: the breeding of crop varieties that are less susceptible to pests (insect pests, diseases, nematodes, weeds and so on).

3) *Biological control*: the conservation and manipulation of natural enemies; the introduction of exotic natural enemies; and the use of microbial pesticides.

4) *The rational use* of chemical pesticides with economic thresholds.

5) *Legal control*: the enforcement of measures and policies that range from quarantine to integrated land and water management practices. This approach to pest management must involve area-wide operations that include many rural households if the benefits are to be widely felt.

6) *Mechanical control*: use of tools or machinery, especially important for weed control.

Source: Adapted from Pimbert, M. 1991. Designing integrated pest management for sustainable and productive futures. Sustainable Agriculture Programme Gatekeeper Series 29. IIED, London.

residues to control bean pod weevils (*Apion godmani*), and sampling to lower pesticide use for fall army worm (*Spodoptera frugiperda*), bean leafhoppers (*Empoasca kraemeri*), bean pod weevil and other invertebrates (Andrews, 1989; CATIE, 1990; Hallman and Andrews, 1989). IPM extension programmes have recommended biological pesticides like *Bacillus thuringiensis*, live barriers for soil conservation, intercropping, and other techniques which protect pests' natural enemies.

Often cited obstacles to adoption of IPM in the region include:

- Missing technical information
- A weak public sector
- Inappropriate credit and subsidies
- Influential agrochemical companies
- Agroecosystem complexity
- Language barriers

Missing Technical Information

In Central America, Belize and Panama there are only about a dozen IPM researchers with postgraduate degrees working full-time for smallholders. This has seriously limited the extent of scientific knowledge that is an essential basis for IPM experimentation. Incomplete biological information limits IPM development. Some pests were recognised only recently, for example maize seedling weevil, *Listronotus dietrichi* (Rueda et al., 1985) and *Fusarium maydis* and *Diplodia* (*Stenocarpella*) spp., the causal agents of maize ear rots (del Rio, 1991). Life cycles, natural enemies, habitats and distribution are often poorly understood. Only 5% of the parasitoids in the Central American agroecosystems have been catalogued.

Although scientific understanding of the agroecosystem is necessary, it is not sufficient to induce smallholders to adopt IPM. *Campesinos*[1] have rejected IPM techniques developed even for those few well-studied pests like fall armyworm and bean slugs (Andrews, 1988; 1989). As discussed later, technologies designed without farmer input are often useless to farmers.

Weak Public Sector and NGO Difficulties

Central American public sectors are poorly funded, with frequent policy and personnel changes. Extension agents' jobs may depend more on supporting their party's electoral campaign than visiting farmers. Government extension agents live in cities and often moonlight. Cars and fuel are limited. Some extension agents make extra money by selling pesticides in the villages from government cars (Bentley and Andrews, 1991).

Some IPM specialists avoid the frustrating public sector and work with NGOs (nongovernmental organisations) which are smaller, less bureaucratic and often hire people with farm backgrounds. Many Latin American countries are assigning most or all extension services to NGOs (see Farrington and Bebbington, 1991).

The success of NGOs in the extension of new techniques is illustrated by the work done by World Neighbors in the Honduran villages of Giiinope. For example, although World Neighbors had left the area, villagers in one of the villages still told us and each other about the soil conservation and nutrition topics they had learned from World Neighbors extensionists[2]. Farmer Tomàs Ferrera opened a half-rotten corn stalk and squeezed water from the core to show us that he no longer burned crop residues because the maize stubble retained moisture that his field needed.

However, we were frustrated teaching IPM to villagers who had other priority concerns such as drought. We thought our IPM message would be better received if it was part of a broader NGO agricultural programme (Goodell, 1984; Goodell *et al*, 1990) which could reach thousands of people. For three years we taught NGO para-technicals about IPM, which they had agreed to teach to farmers, along with health, nutrition and agricultural topics.

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1. A Spanish word meaning the rural poor, especially smallholder farmers.

2. For more details of this work see Bunch, R. and López, G. (1995). Soil recuperation in Central America: sustaining innovation after intervention. *Sustainable Agriculture Programme Gatekeeper Series* 55. IIED, London.

Unfortunately, the para-technical people were not as motivated or as confident teaching IPM as they were with soil conservation, even after several days of IPM training and follow-up visits from Zamorano IPM specialists every six weeks. Para-technicals used pedantic terms like "*diplodia*" and "*coleoptera*" to show off to their neighbours. Evaluations in the Philippines showed that IPM training deteriorated after being taken out of the hands of 'enthusiastic master trainers' (Matteson et al., 1994). We need more experience to fully realise the potential of NGOs as IPM instructors.

Inappropriate Credit and Subsidies

Public and private extension agencies often discourage IPM through subsidies to agrochemicals. Credit packages fund herbicides, but not hand weeding. There are no loans for farmers to hire pest scouts. Government agronomists prescribe pesticides to farmers' cooperatives before the pests even appear, and discourage farmers from planting native maize varieties.

Central American governments have subsidised pesticides, making them artificially competitive (Murray, 1994; Rosset, 1987). Central American governments are finally ending agrochemical subsidies and credits. Higher chemical costs and less credit are stimulating farmers to use more local resources like cover crops instead of herbicides and urea, cultural controls and natural enemies instead of insecticides.

Influential Agrochemical Companies

Douglas Murray blames much of the failure of Central American IPM on agrochemical companies. Their salespeople are everywhere, handing out baseball caps and throwing parties. Payment on commission rewards pesticide vendors for one thing only: selling more pesticides (Murray, 1994). Public sector extension agents sometimes accept bribes from merchants for persuading *campesinos* to buy the seeds and chemicals a merchant has in stock.

The private agrochemical sector has many irregularities. Salespeople are under-trained. Most do not know the correct way to clean up insecticides spilled on the shop floor. Merchants pour pesticides into plastic bags and drink bottles, and sell fungicides to cure viruses. Some pesticides and other products in Central America are adulterated or worthless.

However, the agrochemical industry is becoming more responsible. Multinationals are sending local dealers on pesticide management courses and are promoting safety and rational use courses for farmers and extension agents. Several brands of *Bacillus thuringiensis* are now sold. Educating consumers and the industry itself is probably our best tool for working with business.

Agroecosystem Complexity

Central America is no larger than California (or Sweden, or Thailand), but has as much agroecological complexity as the continental United States. The people of the isthmus are diverse, and include Native Americans, Afro-Caribbean people and Hispanic smallholders, rural elites and staff of multinational export firms. IPM information for *campesino* bean farmers in the pine savannahs may be useless for Native American Miskitos with rain forest clearings or for commercial bean growers. Even if there were IPM scientists working everywhere, their system-specific work would help few farmers and have less economic impact than in homogeneous areas. We need robust technologies that work in many agroecosystems, or many site-specific ones. One way to achieve this is by supporting farmer innovators, and this will be discussed below.

Language Barriers

Otherwise educated, sensitive Latin Americans commonly believe that peasant farmers have such small vocabularies that one must talk to farmers as though they were children. This is nonsense. Honduran smallholders know hundreds of words for invertebrates and for plants and have complicated lexicons of farm equipment. City and country people may have little vocabulary in common to discuss agriculture. With time, motivated extensionists learn many local words, although scientists and project managers tend to learn fewer.

Local names for plants, animals and tools are even more complicated because many change from region to region in Central America. Our personnel learned the various common names of many dozens of insects. Learning new words is easier than forgetting pedantic ones. A recent manual for Guatemalan peasant farmers defines insects as: 'arthropods with six legs, antennas and three body parts' as though farmers didn't know what 'insect' meant, but understood 'arthropod'. We once made the mistake of explaining that arthropod predators were 'hunters' and that there were two kinds: 'ambushers' and 'searchers'. When our team member Werner Melara went back to a community in Choluteca, NGO para-technicals we had trained were trying to define the difference between predators and hunters. They had forgotten that the words were synonyms. Our message had been too pedantic.

Attitudes and Perceptions of IPM Research and Development

In summary so far, roadblocks to IPM include missing technical information, weak public sector, bad credit and subsidy policies, irresponsible business, agroecological complexity, and language barriers. Although some limit research and development (R&D) on IPM, most can be mitigated. However, often the most serious and easily overlooked barriers are the attitudes and perceptions of IPM specialists. These are the only limitations entirely within our control and so should be the easiest to correct. In our experience, IPM specialists' assumptions about the use of media, labour and capital supply, surveys, sampling and the research agenda limit successful IPM adoption.

The Use of Media

Like almost everyone, we once assumed that visual aids are effective extension tools. However, in a long-term, quantified comparison of extension media, we discovered that farmers learned as much from talks without slide shows as from presentations with visual aids. Some of the results are shown in Table 1.

Table 1. Before and After Farmer Test Scores in 15 Agricultural Cooperatives in Honduras in 1985

Based on six talks per cooperative about maize and bean pests: fall armyworm, slugs, empoasca, bean pod weevil			
	Average grade before (%)	***Average grade after***	***Average increase***
Average score			
with visual aids	40.4	72.5	32.1
without visuals	41.1	71.9	30.8

Source: Fisher, Barletta and Andrews (1986)

Although talks are more effective than pamphlets, written material is inexpensive and can reach more people. We used to publish comic-book pamphlets for farmers, complete with love stories, bad jokes and tales of hermaphroditic slugs. Farmers were distracted, sometimes offended and the writings didn't teach people much (Goodell *et al*., 1990). Jokes are more useful in talks, to review or introduce concepts and make the extension agent seem approachable. In pamphlets, farmers prefer naturalistic line drawings and clear, technical prose (Bentley and Andrews, 1991).

Assumptions About Labour and Capital

Like other IPM specialists, we assumed that new technologies for smallholders must cost no money, but could use labour extravagantly (Box 2). However, smallholders may be hungry, exhausted and uninterested in tedious, uncomfortable tasks. They may be unable to hire labour. Farmers would rather use paraquat than machetes and would rather set poisoned bait than kill slugs at night with sharp sticks.

Box 2. Understanding Limitations to Adoption

Our menu of slug control techniques included the "trash trap": piles of cut weeds and stubble between rows of maize, turned over every two or three days to find the slugs hiding from the sun. We thought it was a sound idea, costing no money, and using labour when there was little other on-farm work. Slugs could be eliminated from a maize field in the first half of the rainy season, so beans could be planted during the last half, between the furrows of drying corn. Despite some farmer interest and experimentation, however, adoption rates were low, mainly because the sharp edges of maize leaves scratch people's faces as they walk through the corn under the August sun (Bentley and Andrews, 1991).

Smallholders are willing to spend some of their scarce capital to avoid drudgery or improve yields. We learned to offer a menu of technologies, using different ratios of labour and capital and let the farmers choose (see also Braun et al., in press). With effective techniques that save labour and capital, adoption is fast (Box 3).

Box 3. The Potential for Adoption

We were concerned that as vegetable growing became popular in Honduras after the late 1980s, farmers were using insecticide against fire ants (*Solenopsis geminata*), which eat seeds, but are also enemies of insect pests. The best alternative to pesticides was to plant the vegetable seed bed on a table of wooden poles, with the feet in cans of water. The table blocked the ants, but it used four cans, much wood and labour and encouraged using the same soil repeatedly, which could build up disease pathogens. Almost by accident, while helping Eloy González on a thesis project with ants, the project anthropologist thought of planting the seed bed on the ground, and sprinkling raw rice (or any other grain product) on the seed bed. The ants carry off the rice and leave the vegetable seeds. Once the seedlings germinate, the ants still forage in the seed bed, killing insect pests. The technique is more effective, but costs less money and labour than chemical control. Farmers are quickly adopting it.

An Over-reliance on Surveys

Most IPM researchers claim sensitivity to small farmers, but act as if contact with them is the last step in research. IPM specialists may commission a farmer survey, usually with too many questions, little analysis, and the report is written poorly, or goes unfinished (Chambers, 1983). A few days spent chatting with farmers might be more useful than the survey. Start with the farmers instead of treating them as inconveniences to be addressed later by extensionists. Good IPM is not formal research imposed on growers, but a social act by technical specialists responding to and helping to define clients' needs.

A smallholder IPM programme that balances research, extension and scientist-aided farmer innovation is flexible enough to address whatever factors may be immediately limiting adoption. In some cases, the emphasis can be on extension (with some research). At other times research solves a key problem. For example, our team got interested in ants because of Lorena Lastres' (1990) thesis on fire ants as predators (research). We taught farmers that ants were beneficial (extension) and some farmers responded by inventing technologies for manipulating ants, discussed above (scientist-aided farmer innovation). Robert O'Neil, entomologist at Purdue University, is evaluating these farmer innovations with his student, Luis Canas, through formal experiments (research).

An Over-emphasis on Sampling

Farmers will not adopt numerical sampling[3] (see Matteson *et al*., 1994; Escalada and Heong, 1994, Goodell, 1984). Leafhoppers are green specks that spring off an infested bean plant in all directions when the plant is touched; they are impossible to count. Even a seemingly simple strategy like 'apply insecticide if there are armyworms in 40% of maize plants' will confuse farmers who do not know what 'percentage' means, and may be too busy to count armyworms. A few years ago we simplified sampling enough to make some entomologists laugh at us, but farmers still did not adopt it (O'Neil et al, 1989). No quantitative sampling strategy will be acceptable to smallholders who lack the arithmetic and the time to count several pest species in their small fields every few days.

In theory, thresholds are flexible, but in practice they are static (Szmedrae *et al*., 1990; Goodell, 1984; Escalada and Heong, 1994). Thresholds ignore fluctuating commodity and pesticide prices, and hidden costs and benefits (Rosset, 1987). Thresholds ignore the transaction costs of over-night bus trips to buy supplies. Even the chemical industry now supports sampling, confident that sampling will help maintain pesticide sales.

Sampling would probably save farmers few spray costs. Some Filipino farmers learned sampling, but refused to adopt it, claiming that they could assess pest populations visually, without counting or sampling for pests (Adalla, 1990; Matteson *et al*., 1994). There is little point to sampling without recognising natural enemies. It is more important to help farmers understand the threshold concept and its relevance, and let them find their own thresholds, rather than teach them rigid formulas (Waibel, 1990).

Setting the Research Agenda

A scientific research agenda that does not take farmers' priorities into account may well be

3. IPM does not prohibit chemical pesticides, as long as the crop is sampled for pests (inspecting various parts of the field at random and calculating the average number of pests per plant) and avoiding applications unless pest populations reach the economic threshold level. This is the pest density at which the economic benefits of pesticide application are greater than the costs.

funding personal research interests at public expense. When research results are not presented to the farmers an opportunity is missed for early evaluation and fine-tuning. For example, we know some scientists who are conducting a rigorous tillage experiment, comparing pest and natural enemy populations (and other data) in ploughed fields versus unploughed fields. The results show how farm ecology changes quantitatively over the years under the effects of zero tillage, which is widely proposed as crucial for sustainable agriculture. The scientists have not asked farmers to see the plots or the results, and have missed the opportunity to incorporate farmers' perspectives into this important and otherwise thorough research.

This does not mean surrendering all research or even the research agenda to the farmers. Smallholders, like all people, can have mistaken notions of self interest. In the mid 1980s when we asked farmers to guide our R&D, they requested pesticide efficacy trials. By 1992, farmers had learned of pesticide-related health problems from NGOs, the radio, and their own experience. Now farmers wanted recipes for botanical insecticide. We began to study neem trees and native plants that farmers identified, but we did not make botanical insecticides our priority because we felt they are of limited value. An insecticidal plant may kill beneficial insects and create resistance, just like synthetic insecticides, and some plants are poisonous to people. Botanical insecticides may be little more than agricultural placebos. By applying a useless blend of mashed plants and water, instead of insecticides, farmers can allow natural enemies to become more abundant.

Farmers can discuss the research agenda during farmer workshops, which can begin early in a programme, before research. The workshops create common concepts and terms between scientists and farmers, allow farmers to exchange ideas and help document farmers' practices (Rodríguez and Bentley, 1995).

Helping Farmers to Innovate

IPM specialists commonly think that the logical sequence of IPM research and development is:

1) identify a pest problem
2) develop a technology
3) extend it to farmers

But it could take three to five years just to replicate the trials. Farmers are inventing all the time, and even a small increase in the creative power of several thousand farmers could lead to many novel techniques. By 1991 we had adopted a radical approach:

1) learn the gaps in farmers' knowledge
2) extend the missing information to farmers
3) farmers develop technology

Many farmers invent technology after learning about pest life cycles and natural enemies (Box 4). Most Honduran farmers do not know about natural insect enemies, nor do Bolivian farmers (Vélez, 1994). After we taught hundreds of farmers that social wasps and ants are predators, several farmers invented sugar water to spray onto crops to attract wasps and ants to prey on caterpillar pests. Other farmers we have trained have invented ways of moving native fire ant nests into fields and planting fruit and shade trees as social wasp habitats (Bentley *et al*, 1994).

Box 4. The Impact of an IPM Programme

A two-year evaluation of Zamorano's IPM programme by Catrin Meir showed that a year after training, farmers remembered key concepts, such as that insects reproduce sexually (not by spontaneous generation); that many insects are natural enemies of pests, and that insecticides kill beneficial insects. Some farmers had forgotten certain details, like whether a given insect has three or four major life stages. All the farmers Meir talked with had stopped killing ants, wasps, spiders and toads. Some farmers had invented new techniques: leaving maize stalks in their fields as habitat for beneficial earwigs, moving ant and wasp nests onto their fields, killing insect pests by hand, including eggs (which previously they had not recognised). Several farmers applied sugar water to attract ants and wasps, which our team had learned from Uvalda Castro and other farmers, and taught to others (Meir, 1995).

Many farmer inventions can be adopted easily by other farmers. Farmer inventions cost little or no additional money or labour. Scientists' inventions are not always so elegantly integrated into existing farming systems as those of farmers.

Experimenting with farmers is easier said than done. In 1989 we taught farmers about fungal disease and showed them spores under microscopes, to encourage farmer experiments. However, the results were somewhat discouraging (Bentley and Melara, 1991). Teaching pathogen biology and ecology to farmers to stimulate farmer experiments was much improved in 1994 when Stephen Sherwood designed a programme to teach farmers the biology of plant disease. Sherwood and other team members gave the two day course 13 times in Honduras and Nicaragua. During seven of these, farmers suggested 273 management alternatives for crop disease. The farmers' recommendations (e.g. select seed, disinfect seed or seed bed, improve soil nutrition) resembled plant pathologists' recommendations. The advantage of Sherwood's approach lies not just in the techniques the farmers thought of, but in the fact that the farmers thought of these themselves, gained more self-confidence and were probably more likely to adopt the practices than if an extensionist had presented them (Sherwood, 1995; Sherwood and Bentley, 1995).

Some innovations will still depend on scientists because they have different skills than farmers. Farmers are experts at adapting new crops, varieties and technologies to local conditions (Chambers, 1990; Richards, 1985; Sperling and Scheidegger, 1995), and at manipulating natural enemies. We need scientists for classical biocontrol, breeding new lines from imported germplasm, inventing new chemical inputs and monitoring ecosystems for symptoms of new problems (Andrews *et al*, 1992; Pimentel, 1991).

Summary and Policy Implications

This paper has highlighted the key role that policies and attitudes can play in making or breaking successful IPM strategies. In conclusion, we recommend the following if IPM is to be adopted more widely in Central America. Some recommendations may also apply elsewhere, and to other areas of farmer-scientist interaction.

- Avoid pedantic language. Written materials, if used, should be clear and naturalistic.
- Place more focus on the threshold concept. Farmers will not adopt numerical sampling.
- Avoid surveys. Interact with farmers through research, extension, farmer workshops and scientist-aided farmer innovation.
- Avoid credit and subsidies for agrochemicals.
- Develop robust or site-specific technologies through farmer-scientist collaboration. Diversity of ecological zones complicate IPM development, demanding a menu of techniques that use various amounts of capital and labour. IPM needs robust technologies or many site-specific ones. Both kinds can be developed through farmer-scientist collaboration, which includes inviting farmers to help set research agendas and teaching farmers missing biological information.
- Invest in human capital. IPM is site specific and technological packages are of little use. Farmers and extensionists need better knowledge, more self-confidence and responsibility to innovate IPM locally. Relatively less money should be spent on centralised IPM and on experiment-station research.
- Support biological control. Naturally occurring and applied biocontrol have huge potential. The farmer experiments we documented were with natural enemies and show how farmers become interested in biocontrol as they learn more about it. As consumers demand more organic produce and as pesticide restrictions increase, policymakers should seize the opportunity to join farmer interests with market demands by encouraging biocontrol.
- Respect farmers' creativity. Build extension programmes that inform farmers about the scientific basis of their problems, encouraging farmers to create. Recent experience with pesticides suggests that imposed recommendations can hinder self-reliance and can aggravate environmental, social and agronomic problems.

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