Chapter 8
Impact of IPM Extension for Smallholder Farmers in the Tropics

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Abstract In recent years, IPM extension came to mean FFS (farmer field school). Most studies of FFS pilot projects suggest that IPM helps farmers to lower costs or to increase yields, although the farmers pass on little of their new knowledge to their neighbours, which limits the cost-effectiveness of FFS. Some quantitative studies of FFS suggest that there is actually little overall impact of FFS programs. FFS may be better suited to stimulating collaborative research with farmers than for extension itself. In other words, FFS may help to perfect the extension message (the technology) which can then be communicated with other methods. There are many alternative extension methods available, although their impact needs further study. The challenge is to find methods that deliver quality and quantity messages (reaching a large audience with an appropriate, understandable message).

Keywords IPM · extension · FFS · smallholder farming

8.1 Introduction

The impact of extension depends on an appropriate message, delivered with an understandable extension method, although it is not always that simple. In the scramble to adopt Bt cotton in Warangal District, Andhra Pradesh, India, farmers may be led to plant genetically modified cotton because of clever marketing. Some farmers planted a new cotton seed after being taken to the field of an influential farmer, and given lunch (Stone 2007). In another experience, a group of Bolivian farmers expressed an increased demand for growing quinoa after being given a piece of quinoa cake at a technology fair (Bentley et al. 2007).

However, adoption fuelled only by convincing extension messages may be short lived. In the cotton example above, farmers often abandon the new variety after a single planting (Stone 2007). In the 1990s in Colombia, researchers insisted that extensionists teach coffee farmers to culture the fungus *Beauveria bassiana* (Bb)

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to control the coffee berry borer. A nation-wide network of dedicated extensionists taught the farmers to boil rice, to place it in used rum bottles, and then inoculate it with Bb, with which they would later prepare a solution to spray on their groves. The farmers adopted, and then abandoned the technology because they could not get enough rum bottles, and could not keep the rice medium sterile in their kitchens, plus the whole operation was too much work, and took up too much space (Bentley and Baker 2002).

In 2003 I saw some excellent extensionists in Nicaragua, trying to teach farmers to calculate the percentages of pest incidences, using a complex pest sampling chart divided into about 625 squares of data (personal observation). The chart had rows of sampling sites and columns for different pests. It arguably offered a complete picture of all the pests and diseases in coffee, but it took 20 people two hours (i.e. 40 person-hours) to gather the data. Even the agronomists had to use a calculator to figure out all the percentages. The sampling scheme "worked" but it demanded too much time, and math skills. The sampling method was never adopted, even after persistent extension efforts.

While there is not a direct, mechanical relationship between extension method, message and impact of a program, method and message still have to be taken into account. In recent years the IPM message has been linked with one particular extension style: farmer field schools, even though IPM can be taught with other methods, and FFS can be used for other messages.

8.2 Evaluation of Farmer Field Schools

Farmer field schools (FFS) became a kind of standard in IPM extension after the late 1980s, even though they are now being questioned. In spite of the great interest they enjoyed, the evaluation of their impact is hardly straightforward. FFSs were created by the FAO IPM in Asia program in the 1980s to teach Indonesian farmers to avoid needless insecticide applications on rice, especially for white rice stem borer and brown plant hopper. An FFS teaches about 25 farmers at a time. They meet once a week for half a day during the whole cropping cycle. In theory, the FFS do not involve lectures (Gallagher 2003), although field observations show that the facilitators do actually give talks (Winarto 2004, Palis 2006). This is not a criticism; talking is a legitimate way of conveying ideas, but it does suggest that the designers of FFS over-packed the method with unhelpful rhetorical baggage.

The first attempts to measure impact were qualitative. This was a useful first step. Anthropologists Vayda and Setyawati (1995) found that while taking a field school, farmers in a village in Indonesia learned much about insect natural enemies, and began to use pesticides less often.

During an intensive, two-year study of a village on Java, Winarto (2004) found that FFS graduates experimented with the new ideas, e.g. inventing early ploughing, and hand collecting egg masses to control white rice stem borers. Ooi (1998) also found that farmers experimented after taking an FFS. Winarto learned that farmers who took the training were flattered to be involved, and took it seriously. They once organized a trip to a research station to ask researchers questions which had arisen during training. The farmers enjoyed the FFS, but it was difficult for them to teach the messages to their neighbours, because the messages were complex, because the farmers did not have a convenient time and place to convey the information and because the untrained villagers were sceptical. Farmers were also disappointed that researchers did not visit them to learn about the farmer inventions (Winarto 2004).

Various studies show that farmers adopt the principles taught in FFS. For example, a study in the Philippines found that FFS farmers had learned enough from the field school to adopt organic rice growing (Carpenter 2003). A study in Peru found that potato farmers who had attended FFS had higher yields than their neighbours (Ortiz et al. 2004, see also Godtland et al. 2004). In the Central Philippines, a long-term village study showed that farmers learned to observe insects in the field school, and that each year fewer of them used insecticides, until some six years after training, when all or nearly all of them had stopped spraying for insects in rice (Palis 2006). A study of cotton farmers in Southern India showed that IPM adoption (following FFS) reduced pesticide use by 78% without affecting crop yields, suggesting that IPM is profitable and that much of the current use of pesticides is unnecessary (Mancini 2006).

However, quantitative studies of some of the original FFS cohorts by Feder and colleagues raise doubts. They found that the most prosperous farmers had been preferentially chosen for the field schools, biasing the results. There was little difference between FFS graduates and their neighbours; i.e. the FFS graduates were not getting better rice harvests, and were not using less pesticide. Trained farmers were not teaching their new IPM knowledge to their neighbours (Feder et al. 2004a, 2004b). This is a problem because only about 25 people can take an FFS at one time. Small class sizes help ensure a quality experience. However, if the 25 people who take a field school do not teach the information to their neighbours, a message that reached more people might be more effective. Rola et al. (2002) also found that FFS graduates do not teach new information to friends and neighbours. van den Berg and Jiggins (2007) critique Feder et al.'s methods, e.g. arguing that information might have spread from IPM farmers to the non-trained ones, and that the study gave insufficient attention to savings in insecticide by IPM farmers. There is clearly a partisan flavour to this debate, and various other studies do suggest that the results of FFS are often modest. For example, Ricker-Gilbert (2005) in Bangladesh concluded that a visit from an extension agent was a more cost-effective method than FFS for teaching IPM technology.

Rice farmers in Bangladesh who had taken FFS could not identify planthopper nymphs; most thought the nymphs were related to stem borers (which are lepidopterans, i.e. entirely different insects). After IPM training by various NGOs, few if any farmers practiced new techniques that they were taught, because the technologies were perceived as being labor intensive or risky. Over time, farmers tended to forget much of what they were taught (Robinson et al. 2007).

Two reviews of African field schools suggest that FFS do lower pesticide use and raise yield, but that these benefits do not spread beyond the FFS graduates, in part because farmers are not rewarded for taking time to teach others. Also, field schools are not integrated into local extension programs, churches or other grassroots organizations. Field schools are expensive and dependent on foreign donors. Their impact has not been sufficiently evaluated, but FFS are probably not a feasible model for national extension programs, at least not in Africa (Davis 2006, Anandajayasekeram et al. 2007).

One rather sobering review of insecticide use suggests that despite the popularity of IPM, insecticide use is increasing around the world, even in areas that favour IPM, like California and the UK. Perhaps insecticide use would have been even more widespread if not for IPM, but it will be unlikely to do away with insecticides, in part because new compounds are being invented which cause lower environmental impacts. The major new pest management technology that is making an impact on the way that insecticides are targeted is genetically modified (GM) crops (Devine and Furlong 2007).

FFS has been a popular IPM extension method in tropical countries for several years, and yet its full impacts and cost-benefit are only partially understood. FFS was already being promoted outside of its pilot areas before its impact was well known.

Most studies of the impact of FFS report reduced expenses for inputs, increased yields, and higher income for farmers. However, most of these studies are of pilot programs, and there is less information on the cost-effectiveness of large-scale IPM Programs (Sorby et al. 2003 cited in Kelly 2005).

A study of FFS graduates, their neighbours and "control" farmers from non-FFS villages in Sri Lanka concluded that FFS graduates do make fewer applications of insecticide than others, and that the field school did teach them about natural enemies and the importance of not making early sprays. However the FFS farmers do not teach what they learn to their neighbours (after all, what people learn through discovery learning may be difficult to transmit by talking). There is little or no impact of FFS at the national level, because so few farmers actually attend an FFS, less than 2% of Sri Lanka's farmers (similar to figures from Indonesia, the Philippines and elsewhere). In other words, FFS does teach valuable ideas to individual farmers, but the new ideas do not spread to others, and national programs are not able to teach enough field schools to directly reach most farmers in the country (Tripp et al. 2005).

8.3 The Message

The first FFS (Rice in Asia) had an appropriate message: natural pest control, with native, natural enemies of insect pests. The message was well suited to the FFS method: talking about natural enemies of pests, observing them in the field. Farmers experimented by leaving a small part of their field untreated with insecticides. Then they observed the counter-intuitive results: there were fewer pests without insecticide. The new technology (no insecticide) was cheaper and easier to use than the technology it replaced (insecticide abuse). This fortunate match of message and method helped to make FFS appealing, but when FFS began to be applied more widely, pesticides were occasionally added to the curriculum.

For example, when FFS came to South America in 1999, it was forced to include fungicides, for late blight in potatoes (Nelson et al. 2001). In Bangladesh a large, international NGO received training from some of the best experts in FFS, and conducted a widely-publicized FFS program. After the project ended, some of the staff formed their own NGO. By the early 2000s, the problem in Bangladesh was labor shortage, as young people took jobs in the garment factories. Farmers could not hand weed all their own rice. In 2005 I interviewed extensionists and farmers in Bangladesh, who were excited about having conducted an FFS to teach herbicides. The extensionists taught the farmers to apply herbicides to the water in the flooded field, and to count days of labor, keep costs, and to observe fish and frogs, to ensure that wild animals were not killed by the chemicals. Farmers had been reluctant to try herbicides, fearing they would damage their land, but were pleased with the results. FFS is versatile enough to teach many messages, including chemicals.

There are many versatile extension methods available, but choosing the message is often more difficult. When the coffee berry borer entered Colombia in the early 1990s, researchers were keen to find an alternative to chemicals. They tried Bb, which failed. They invented sampling methods which took six hours to conduct, so no one would adopt them. They brought parasitic wasps from Africa, which did become established, but which parasitized only 5% of the berry borer population. Five percent fewer pests is a significant savings in a crop as valuable as Colombian coffee, but farmers still demanded more control (Baker 1999, Bentley and Baker 2002).

Through rigorous entomological studies, researchers knew that the borer only lived in coffee berries. It had no alternative host. So by gathering up all berries from the ground and by gleaning over-ripe fruit from the trees, the growers could eliminate the pest's habitat. Researchers called the gleaning-plus-clean harvest "Re-Re." Extension agents taught Re-Re, but farmers would not pick fallen fruit from the ground. The hillsides were usually so steep that bending over was uncomfortable and could lead a person to slip or fall; the fallen fruit was often hidden by leaves. The berries on the ground were often rotten and could not be sold. But farmers adapted Re-Re, and began to make more of an effort to harvest all the coffee berries from the trees (clean harvest), because the good berries could be sold, which usually paid for the labor to pick them. At first researchers and extensionists were displeased that farmers were modifying Re-Re, but they eventually realized that the farmer modifications made the technology more acceptable, that clean harvest was being adopted, and it was controlling the pest (Aristizábal et al. 2002).

Clean harvest is also being used by farmers to control the coffee berry borer in other parts of Latin America and in India. Even though Re-Re is a low, unglamorous technology, farmer modifications made it simple and functional enough so that others would use it.

FFS may be more useful for research than for extension, because it gives scientists a chance to see how farmers react to scientific ideas, and because the FFS permits farmers to understand the reasons behind a new technology, and to suggest improvements (Paul Van Mele, personal communication). In the 1990s, a Swiss-funded project by Zamorano in Nicaragua and El Salvador taught farmers using various FFS (some farmers learned about maize and beans, some learned about vegetables, etc.). Farmers combined the new ideas creatively with their own knowledge, even though the program did not actively encourage them to do so. Some of the changes were especially useful. For example, twenty years earlier, in the 1980s, researchers had tried to develop "trash trap" (piles of leaves, where slugs would hide; farmers could turn the piles over and kill the slugs by hand). The original traps did not work very well, but over the years the farmer experiments improved them in several ways (e.g. combining the traps with commercial pellets, using old sacks as the traps), which made them more practical (Bentley 2006).

Field schools are starting to be combined with CIALs (the Spanish acronym for "local agricultural research committees"), to fine tune technologies (Van Mele and Braun 2005, Braun et al. 2000). Researchers in Peru used FFS and CIALs to invent cultural controls for bacterial wilt in potatoes. The farmers who had studied in FFS liked the experience, and readily agreed to stay organized, but as a CIAL. Many technologies came from the experience. One of the most interesting was a set of rotational crops for reducing the bacteria in the soil. This was investigated in formal trials, under the leadership of the researchers, with collaboration from the farmers. Some of the technologies emerged serendipitously. For example, researchers taught farmers to clean their sandals with lime before entering a field, so as not to track in bacteria. CIP plant pathologist Sylvie Priou noticed that when farmers ran out of lime, they used wood ash instead. She tested the ash in her laboratory and found that it effectively killed the Ralstonia bacteria (Bentley et al. 2006).

FFS experts are now arguing that field schools "are not meant for technology transfer" and there is a need to experiment with how to combine FFS with mass media, extension etc. (Braun et al. 2006).

8.4 Reaching the Largest Audience Possible

Once the IPM message is right, the challenge is to take it to as many people as possible. There are basically two types of extension methods: face-to-face (i.e. people teaching other people), and mass media.

Face-to-face methods are not necessarily limited to small audiences. Promoters are a kind of farmer extension agent, which are popular in Central America, due to World Neighbours and other institutions. They are a low cost, personal way of reaching many people, which allows the technology to be adapted by the people who will use it. In Central America, farmers burned crop stubble from fallow lands every year before planting. This killed pests, and released nutrients as ash for the crops, but it also increased soil erosion. Burning was common until the 1980s, but has now stopped almost entirely in Central America, thanks to efforts by promoters linked with Elías Sánchez, World Neighbours and other.

Morales et al. (2002) found that the promoters were a kind of filter for technologies, simplifying them and passing them on. For example, in 2001, when the Nicaraguan Ministry of Health insisted that coffee growers keep coffee pulp out of streams, NGOs responded by inventing a kind of cess pool for coffee. It was made of two pits, with a wooden sluice between them and a gravel filter in a bucket. Farmer promoters saw the technique, and adapted it, by making just one pit. This saved on expenses (no wooden sluice, no plastic bucket), but it also kept coffee pulp out of streams. The promoters had grasped the essential concepts of the technology, but redesigned it to be much more affordable.

Picture songs in Bangladesh: singing and dancing about IPM, while showing large illustrations

In Bangladesh, one innovative NGO, Shushilan, used "picture songs" (song and a very large painting on a scroll) as a kind of moving picture, to teach appropriate rice technology to thousands of people, especially about natural enemies and using organic fertilizer. As a performer sings out the message (and dances), the rest of the troupe accompanies her with music, and rolls out the illustrations on the scroll. Hundreds of people can see each memorable performance at one sitting, and as of 2005, some 25,000 people had seen and heard the message (Bentley et al. 2005).

Videos have been used in Bangladesh, combined with farmer participatory research, and community meetings. Researchers at RDA (Rural Development Academy) developed appropriate rice seed technology with farmers (e.g. drying rice seed on a bamboo table, keeping seed dry in a painted pot). Then they made videos where farmers spoke on camera. Their honest words were convincing to other farmers, who could identify with them. Extension agents showed the videos in communities, and then answered questions from the audience, which allowed many people to be trained at once, in a relatively short time (Van Mele et al. 2005, Van Mele in press).

An evaluation in Bangladesh in eight villages (in four districts, around the country) show that one year after villagers watched the videos mentioned above, they had improved their seed storage practices, and had adopted various technologies recommended in the videos, and abandoned other practices which the videos discouraged.

Adoption of seed health technology in Bangladesh one year after seeing videos

Seed storage method	Before (%)	1 year later (%)
Not recommended		
Gunny bag	27	13
Motka (large earthen jar)	28	11
Earthen pot	9	6
Recommended		
Poly bag	24	56
Metalic drum	7	7
Painted earthen pot	0	3

Source: adapted from Harun-Ar-Rashid (2007)

Plant health clinic in Bolivia: farmers consult the weekly clinic at a farmers' market

Plant health clinics are a new extension method being implemented in Nicaragua, Bolivia, Uganda, Bangladesh and elsewhere, pioneered by the Global Plant Clinic. They started in Bolivia in the 1990s, so farmers from distant areas could bring plant samples and get advice about plant health problems. Most of the clinics are "mobile" (only open one morning a week, e.g. on fair day, when the small town fills with farmers from many kilometres around). The plant clinics provide a place for personalized consultations between farmers and agronomists. The plant clinics can be easily combined with other methods like fact sheets, radio, short courses (Danielsen et al. 2006).

Going Public is another face-to-face method for a mass audience. An extensionist goes to a market or another crowded place, and delivers a short message, and then repeats it. The audience comes and goes, but if the message is kept to five minutes, several hundred people can hear it in a few hours. It is especially well suited to rather simple messages that must show something (e.g. a disease symptom, a new tool). Going Public has been used in Bolivia, Bangladesh, Uganda and elsewhere (Bentley et al. 2003).

Going Public in Kenya: Nelson Wekulo tells a crowd how to vaccinate hens for Newcastle disease. IPM topics work equally well with this soap-box style of extension

Written material in Bolivia: Gonzalo Sandoval (*left*) hands out fact sheets on onion diseases, and discusses them with farmers

Written material, including fact sheets, journals and newspapers are also useful, especially when written for farmers and validated by farmers before distribution. In India, coffee farmers in Karnataka have journals and magazines in their homes. *Adike Pathrike* is a magazine that started as a newsletter in the 1980s and rapidly expanded. It is published entirely in the Kannada language. It has a color cover and additional black and white photos inside. Almost all of the material is based on farmer experiences. Although the title literally means "areca magazine" only 10% of the material is on areca. But whatever the topic, the new technology described has to be validated by farmers, even though agricultural scientists write most of the material. The readers are solid commercial growers, family farmers who are literate and who can afford a magazine. The strong local tradition of publishing and reading also helps. Advertisers help keep the costs down, and a good postal system helps to move it. Journals would not be effective everywhere, but in this situation they are (Padre and Tripp 2003).

Radio is a promising method, and has been used recently in Vietnam to teach people to avoid insecticide abuse in rice. A project using radio, leaflets and other media led to a 53% reduction in insecticide use and no loss in production in project sites, and the change eventually spread to more than a million rice farmers three years later (Escalada and Heong 2004). Vietnam recently experienced an outbreak of a virus disease in rice. Researchers helped to adjust an environmental radio soap opera to communicate essential information to farmers. This together with leaflets, TV broadcasts reached two million farmers in three months and spread the use of the "Escape Strategy" (light traps to detect peak immigrations of the brown plant hoppers that transmit the virus, to make group decisions as to when to plant in order to escape virus infection though synchronized rice planting). The "escape strategy" helps farmers to avoid virus transmission without pesticides and is now widespread in the Mekong Delta (KL Heong, personal communication).

A study in Bolivia compared FFS to radio and community workshops, which are like FFS, but more people attend, as many as 80. Community workshops only meet three times instead of a dozen, saving time and expense. The community workshops were nearly as effective as FFS at getting a message across, and the radio made a respectable showing, but at a fraction of the cost (Bentley et al. in press).

8.5 Impact of IPM Extension

Studies of other IPM extension methods are even harder to find than evaluations of FFS. But there are a few.

Like the brown plant hopper in rice, the fall armyworm in Central America is a pest of maize which is usually controlled by its natural enemies, as long as people do not spray insecticides. IPM training in Honduras in the 1980s used short courses, but like FFS the courses emphasized learning by observation. Honduran farmers who had taken IPM training could name more natural enemies, and were less likely to use insecticide than neighbouring farmers who had not taken IPM courses. However, the

IPM farmers were not likely to practice other technologies they had learned on courses (like using sugar-water to attract natural enemies) and over time some farmers came to doubt that social wasps (Vespids) were effective predators of army worms, because farmers observed that the wasps were abundant when there were also high levels of armyworms in their maize (Wyckhuys 2005, Wyckhuys and O'Neil 2007). Local knowledge, behavior, and training interact in non-obvious ways.

In Bangladesh there is now runaway pesticide abuse, especially as farmers grow more vegetables for the ever more sophisticated internal market. In a study sponsored by the Global Plant Clinic, based on in-depth interviews and multiple community meetings in 30 communities, researchers found that farmers used common as well as some unauthorized pesticides, making frequent use of chemicals to control the bean aphid, bean pod borer, cabbage butterfly, brinjal shoot and fruit borer, cucurbit fruit fly, cutworm, banana leaf and fruit beetle etc. In Natore district, farmers made 40–50 pesticide applications to protect a single bean crop from bean pod borer. To protect the brinjal shoot and fruit borer, farmers used the pesticides almost every day and in some cases, 150–200 times in a single crop season. Farmers of Norsingdi district applied pesticides at least 1–3 times in a week on vegetable crops. Some farmers in Natore and Norsingdi district spray high amounts of chemicals to their market crops, but avoid spraying the part they intend to eat at home (Harun-Ar-Rashid et al. 2006).

Part of the problem is that in many countries, there is no longer a formal extension service, or there is a highly fragmented, donor-driven service, which has poor links to research. There are some exceptions. Researchers in Uganda report success with banana Xanthomonas wilt (BBW), which was new to Uganda and was devastating the staple food crop, banana, in the early 2000s. Researchers developed cultural controls, especially twisting off the fleshy, red male flower, because insects visited it, and transmitted the bacteria. BBW control required a simple message, delivered to millions of people, and urgently. The Ministry of Agriculture and various donor-funded programs used a mix of posters, radio programs, newspaper ads, conventional extension and Going Public to get the message out. Cultural control of BBW is catching on in Uganda, not unlike the way cultural control was adopted in Colombia for the coffee berry borer.

A well-funded, well-organized agency can make a difference. For example, in Bolivia after public extension collapsed in the early 1990s, one of the few programs left was IBTA-Chapare (Bolivian Institute of Agricultural Technology), funded by USAID to provide alternatives to coca-growing. One of the alternative crops was banana, which was attacked by the Sigatoka disease. IBTA-Chapare responded with fungicides and also by cutting off diseased leaves. Although slicing off the leaves (with a blade attached to a pole) was tedious, commercial farmers adopted it more or less en masse, in part because the technology worked, and in part because of a well-funded, well-coordinated effort by extension agencies to convey the message to farmers.

Money is not always the answer. Certain well-funded agencies continue to teach dysfunctional technologies after many years. For example sticky, yellow traps were promoted to capture whitefly in tomato as early as 1991 in Nicaragua. They are still being promoted, from Guatemala to Bolivia, 16 years later, even though they do not work. The traps are big sheets of yellow plastic, tacked between two sticks and set out in the field, coated with sticky oil. Insects are attracted to them, stick to them and die. Even a cursory look at one of the sheets shows that many beneficial insects are killed, and many pest insects escape. After a season or so, farmers realize that the traps are ineffective and abandon them. That does not stop extension agents from teaching yellow traps to a new set of farmers. So the traps have been tried, abandoned, and tried again for nearly a generation, all over the American tropics. Extension agents teach them because they are non-chemical, colourful, visual and easy to teach.

8.6 Conclusion

There is still a great deal of work to be done in order to understand the impact of IPM extension in the developing world. There is some cause for optimism; regardless of the method used, most farmers who have received IPM training seem to have either lowered costs, raised their yields, or both. In order to get sound IPM information to as many farmers as possible, at an affordable cost, more extension needs to be done with mass media, especially videos, TV and radio. More work also needs to be done with face-to-face methods that can reach large audiences, but which are not mass media, strictly speaking. Face-to-face extension methods may not be cost-effective in many cases, unless they are used to do more than simply teach farmers. For example, extension can be a way for researchers to learn about farmers' conditions and to conduct adaptive research with farmers, who can then speak on radio or video programs and reach a much larger audience.

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