Transforming Extension For Sustainable Agriculture: The Case of Integrated Pest Management In Rice In Indonesia

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ABSTRACT Investment in agricultural extension, as well as its design and practice, are usually based on the assumption that agricultural science generates technology ("applied science"), which extension experts transfer to "users". This model negates local knowledge and creativity, ignores farmers' self-confidence and social energy as important sources of change, and, in its most linear expression, does not pay attention to information from and about farmers as a condition for anticipating utilization.

In practice, farmers rely on knowledge developed by farmers, reinvent ideas brought from outside and actively integrate them into complex farming decisions. Effective extension seems based on checks and balances that match intervention power with farmers' countervailing power, and mobilize farmers' creativity and participation in technology development and exchange.

Alternative models for informing extension investment, design, and practice stress adult learning and its facilitation. The farmer is seen as an expert and farm development as driven by farmers' energy and communication. The article is a case study of a rare large scale attempt to use such an alternative model. It suggests that a shift to knowledge-intensive sustainable practices requires a learning process based on participation and empowerment.

1. Introduction

Experience with efforts to facilitate learning of more sustainable agricultural practices (*e.g.*, Woodhill *et al.*, 1992; Campbell, 1992; Röling, 1993c; Somers and Röling, 1993) suggests that participation and empowerment must be key ingredients in such efforts.

Sustainable agriculture is not an "innovation" that farmers "adopt". Changing to more sustainable practices is more like a paradigm shift, involving a learning path leading to new perspectives on risk avoidance, new professionalism, a greater reliance on one's own expertise and observation, the use of new indicators and new instruments to make things visible, and usually a greater dependence on collective decision making in cooperation with other stakeholders in the same ecosystem.

Facilitating such a learning process seems very different from regular extension work. Instead of relying on external expertise and inputs, farmers are empowered to rely on their own judgment and observation. Instead of transferring blanket recommendations, such facilitation seeks to enhance farmers' expertise and skills in observation and (collective) decision making. The paradigm shift involved seems easier when learning is experiential and occurs together with other farmers. This calls for participatory and group approaches in extension work. The article will use the Indonesian program for Integrated Pest Management (IPM) in irrigated rice as a generic case to explore these notions.[2]

2. Extension as a delivery mechanism

In most of the developing world, extension has become identified with a "delivery mechanism" for science-based knowledge and technology (considered as "applied science"). The main objective of efforts to improve extension has been to develop the "science-practice continuum" into a super highway, with regular booster stations, such as research-extension linkage departments, subject matter specialists, village extension workers, and contact farmers who each transform and regularly pass on manageable chunks of knowledge considered seasonally relevant and applicable to a wide range of farming and resource-access situations. The linearity of this technology transfer approach has been mitigated somewhat by introducing farming systems research and on-farm research, which allow research and extension planning to anticipate farmers' technology needs. The technology transfer model has dominated decisions about investment in extension, the design of research and extension institutions, the training of staff, and the management of extension and technology development (Chambers and Jiggins, 1987; Kline and Rosenberg, 1986; Röling, 1993b).

This approach has become associated with the "Green Revolution", the rapid diffusion of high yielding varieties and use of high external input packages of seeds, fertilizers, and pesticides, especially in relatively homogeneous farming systems such as irrigated rice.

3. Post-Green Revolution approaches

This article explores the contours of post-Green Revolution approaches that emerge in response to unacceptable consequences of high external technology input. Without going into the definition of sustainable agriculture, it is not very controversial to say one of its key aspects is that it seeks to replace external inputs of chemicals with knowledge-intensive practices that make use of natural processes. The extent of such replacement varies between "guided control", which replaces routine application of chemicals with application based on observation, and "biological agriculture", which rejects all use of industrial chemicals. 'Integrated agriculture' (*e.g.*, "integrated crop production", or "integrated pest management") is somewhere in-between.

It stands to reason that a shift to more sustainable practices has important implications for agricultural extension. One can expect, for example, that, instead of focusing on instructions that accompany the use of inputs, extension shifts to principles that farmers apply when managing an ecosystem. For example, instead of routinely applying a region-blanketing recommendation without knowing the reasons behind it, even 'guided control' requires that farmers have a greater understanding of general principles to be able to take appropriate action based on observation.

We exaggerate these implications for extension a bit below to "whet the eyes of the beholder":

- the perception of the farmer used in extension must change from an ignorant and passive user who is provided with modern technology by external experts, to an active knowledgeable expert who is capable of making complex decisions;
- the type of farmer behavior considered desirable by extension must change from adoption of external innovations to active learning;
- extension strategies and methods must change from technology transfer to facilitation of learning;
- the training of extension staff must change from a focus on transfer techniques (*e.g.*, demonstration) to adult education; and
- the institutional framework must change from a bureaucratized science-practice continuum to a decentralized farmer-driven network.

Such extension would rely heavily on empowerment and participation and would, therefore, not be consistent with the approaches commonly followed in bureaucratic and technocratic government institutions. In this sense, one could expect extension in support of sustainable agriculture to be doomed to ineffectiveness if based in such institutions. In this connection, it is at least to be expected that a shift from technology transfer to facilitation of learning would be accompanied by a great deal of strife, as vested interests (*e.g.*, of pesticide sellers) are threatened and established authority and expertise are undermined.

In all, study of such a shift promises to be of considerable heuristic value for extension science. Study of the shift is also timely. The Green Revolution seems to be petering out in the sense that yields are plateauing, while the costs of inputs are increasing relative to prices of agricultural products. Its environmental consequences are becoming increasingly unacceptable. There are incentives, therefore, to search for a second generation of technologies that focus on reducing inputs, while maintaining the productivity gains made (Agudelo and Kaimowitz, 1989).

4. Indonesia's IPM Program in irrigated rice

This paper presents a detailed case study of the kind of shift described: Integrated Pest Management (IPM) in rice in Indonesia. IPM is one component in a more sustainable agriculture. The paper describes the National IPM Program, which the Indonesian Government is implementing with support of the UN's Food and Agriculture Organization (FAO) since May, 1989. This program was preceded by a Presidential Decree (INPRES 3/86), three years earlier, that banned fifty-seven pesticide brands from rice cultivation, and declared IPM the national pest control policy. A second policy measure gradually reduced the subsidy on pesticides, previously 85%, to zero in January, 1990. These policy measures created a favorable climate for the implementation of Indonesia's National IPM Program. It is the first large-scale attempt to systematically introduce more sustainable agricultural practices as a national, public sector effort. Within three years time, it had trained some 200,000 farmers intensively, and many more by other methods.[3]

The Indonesian IPM Program provides an ideal case to contrast extension for sustainable agriculture with that supporting high external input agriculture. IPM is being introduced into a farming system, irrigated rice, in which the Green Revolution has been successful during the past twenty years.

5. The Green Revolution in rice in Indonesia

The present generation of Indonesian rice farmers has grown up with the Green Revolution. From 1968, when famine threatened the Indonesian people, high-yielding varieties (HYV) of rice were introduced, often by force. Usually, village officials exerted pressure in various ways to promote the Green Revolution technology. In some areas, the crops of farmers not growing the new HYVs were even cut down by village officials, or planting of HYVs and use of fertilizers were enforced by the army. Inputs were distributed through the village administration, which allowed easy control. Moral pressure to cooperate in intensification program was high. When farmers purchased input packages on credit through the Village Unit Cooperative (KUD), they had to take the entire package of seeds, fertilizers, and pesticides prescribed as part of the blanket recommendation covering the entire rice producing area.

Decisions to apply pesticides were often made by officials and entire areas would be sprayed by plane. Farmers could not take paddyland out of production if they wanted to grow more profitable crops. In fact, the policy focused on production, and farmers who might have been more interested in profit found themselves at odds with the goals of the Department of Agriculture.

The coercive nature of the introduction of the new technologies should, however, not be overstressed: farmers soon discovered the benefits and readily adopted the package, at least partly. The present situation is more relaxed. Many erstwhile compulsory measures are now carried out voluntarily. Although farmers feel that rice production with the use of the new technologies is riskier and more of a hassle, they say they are much better off.

However, rice farming is still considered official business. Farmers are treated as if they are the lowliest level of civil servants and considered passive acceptors of official wisdom. Extension's task is to tell them what to do. The agricultural extension system, based on the World Bank's Training-and-Visit (T&V) model, organized farmers into farmer groups (*"Kelompok Tani"*). For extension convenience, grouping is based on adjoining rice areas. Many of these artificial groups do not function in practice. A carefully calibrated scale, based on ten criteria, is used to "grade" farmers and allow them to advance, civil service style, to "progressive farmer". Few, so far, have attained this lofty position.

In all, the Green Revolution seems to have been effective. Indonesia attained self-sufficiency in rice in 1983, after having been the world's largest importer for many years. Price relationships are carefully managed so that most farmers continue to make a minimal living, while rice remains cheap and allows low urban wages. Especially from a national point of view, the approach can be considered a success. The political turmoil that coincided with the famine in the sixties ensures that food security remains a political priority.

6. Beyond the Green Revolution

The Green Revolution seems to have run its course in Indonesia. It seems time for the next "wave" of innovation that will allow farmers to increase efficiency, while maintaining and improving what has been achieved. The productivity of (irrigated) rice is plateauing at about five metric tons *per* hectare. In addition, such high external input farming has a number of problems:

- Serious environmental and human health effects. Such effects include loss of food sources such as fish, frogs and ducks, and poisoning of drinking water supplies. In terms of human health, high exposure is observed among farmers who usually do not wear any protective clothing.

- Threats to food security through vast yield losses as a result of mass resurgence of such pests as brown planthoppers, stemborers, and rice leaf-folders. These outbreaks are the invariable result of the indiscriminate use of pesticides (Van den Bosch, 1980; Kenmore, 1980; Gallagher, 1988). The broad-spectrum pesticides commonly used by farmers kill both pests and natural enemies. This results in massive pest outbreaks, since the populations of pests build up faster than those of natural enemies. A second problem caused by indiscriminate use of pesticides is observed in that farmers tend to make concentrations too high but cannot afford to spray the required volume *per* hectare. Spraying is often very uneven, and, therefore, ineffective. What's more, ideal circumstances are created for the development of resistance to pesticides.

- Many traditional rice varieties appear to have been lost, and with them a store of genetic diversity that took literally thousands of years to develop. Large areas covered by crops of the same genetic makeup create conditions for pests and diseases to spread rapidly.

- Continuous rice cropping in irrigated areas leads to a situation in which pests always find sufficient food.

- Indigenous knowledge (*e.g.*, Warren *et al*, 1991) about some of the components of rice farming seems strangely lacking. Indigenous knowledge of names and life cycles of many pest insects and their natural enemies is virtually absent, partly because many current major pests were not important previously, but also because of the input-oriented technology advocated by extension.

7. The introduction of IPM in Indonesia

Efforts to introduce IPM had started as early as 1979, after Indonesia had experienced its first nationwide brown planthopper outbreak in 1975-77. The attempts followed the transfer approach, which had been so successful in the Green Revolution. Technical assistance was provided by the FAO's Inter-country IPM Program.[4] IPM training activities focused on packages and prescriptions, and were incorporated in routine extension meetings. No clear impact of these activities has ever been reported.

The problems associated with pesticide use culminated in a major threat to food security in 1985-86. During two seasons, an estimated 275,000 hectares of rice were destroyed by the brown planthopper. There are two contrasting stories about the way the problem was appreciated at the national level.

According to the first story, the damage was not apparent at first in the national pest infestation records as a result of a principle called "*Asal Bapak Senang*". This means something like: as long as one's superior feels good about it. The story is as follows. The infestation records are based on sampling reports of special field officers (Pest Observers who are under the Directorate of Food Crops Protection). These reports are amalgamated stepwise as they move up through the administrative hierarchy, from subdistrict level *via* district and province to the national level. Since records of severe pest outbreaks occurring in one's jurisdiction during the crisis years were considered a potential embarrassment to one's superior, brown planthopper damage became progressively smaller at every administrative level. It was only when the home villagers of the President came to him for help, and after pressure from different quarters had led to an independent survey by BAPPENAS, the national planning agency, that the extent of actual damage became apparent. A politically dangerous situation had been created. It was this crisis that led to the Presidential Decree, INPRES 3/86.

But there is also an alternative story to explain the crisis. The yield loss due to brown planthopper damage was systematically over-reported. Fields with some affected areas could be counted as affected fields, and areas in which some fields were affected could be counted in terms of the total acreage of the area. Crop protection personnel over-reported systematically to obtain higher pesticide allocations.

In looking at IPM activities in Indonesia, we must make a crucial distinction between the *extension* effort on which most of this paper focuses, and its *regulatory* and *fiscal* context. The Presidential Decree introduced an impressive array of policy measures that provided important conditions for the extension effort, including:

- prohibition of fifty-seven broad-spectrum insecticides for rice, leaving ten brands (with only four different active ingredients) of narrow-spectrum insecticides, most of them considered specially effective against brown planthoppers;

- creation of 1,500 new pest observer positions within the Directorate of Crop Protection, bringing the total up to 2,900;

- enforced use of resistant rice varieties;

- in several irrigated areas, enforced introduction of one (dry) secondary food crop after two irrigated rice crops, prohibiting continuous wet rice farming;

- crash action through so-called "POSKOs", or commando posts, involving specially trained farmers to give mass applications of narrow-spectrum insecticides, if necessary.

A second major policy measure with regard to pest control was the gradual removal of the 85% subsidy on the price of pesticides.

As a reaction to INPRES 3/86, an IPM training program was implemented through the T&V extension system (Matteson *et al.*, 1993). The Government requested the World Bank to use US$4.19 million remaining for the second phase of the National Agricultural Extension Project (NAEP II) to be used for IPM training. Senior pest observers were trained as "IPM master trainers", and the new pest observer recruits and selected village extension workers were given a six-day crash training program. The trained pest observers and extension workers, in turn, had to train farmers. FAO's Inter-country IPM Program provided technical assistance.

In this crash program, a tremendous effort was made to train a cadre of master trainers, and to develop trainers' guides, flip charts, slide-audio modules, leaflets and pamphlets of which 150,000 copies were distributed by NAEP II. Travel money, honoraria, vehicles, subsistence and pocket money for farmers, and other moneys were paid. The entire budget was spent in seven months, which would have totaled US$ 7 million if calculated on an annual basis. Though the activities had Presidential priority and were facilitated by the Ministries of Finance & Planning and Economic Affairs, only 8.5% of the allocated resources were delivered to the field to train less than 10% of the farmers targeted (10,300 persons). Where farmers were reached, trainers used top-down approaches and did not use the field or farmers' own experiences. Only 25% of the training groups actually entered a rice field. Farmers trained reported not to have learned many new things, and their decision-making remained dependent upon the officials.

The 1990 Review Mission summed up the experience:

> A rigid system equipped to move simplistic messages to a large number of passive farmers could not absorb the energy of IPM's field skills training. A transformation from within was needed to meet the new challenges from outside.

Despite the meager result from this crash IPM training program, the policy measures resulting from INPRES 3/86 were enough to:

- end the threat to food security from massive brown planthopper resurgence induced by the destruction of biological controls;
- save an annual outlay for the insecticide subsidy of between US$ 110 and 120 million a year;
- vastly reduce pesticide imports; and
- make farming more cost-effective, a benefit passed on to urban consumers. Contrary to popular belief fanned by the pesticide industry, careful experimentation has shown yields to be unaffected by the reduction in pesticide use. Environmental and health effects at farm and macro level are less easily measurable, but assumed to be substantial.

In 1989, the time was ripe for the approval for the National IPM Program to start the large-scale implementation of a revised IPM *extension* approach in major irrigated rice growing areas. Having learned from ten years of experience in IPM training and implementation in various Asian countries, the Indonesian model embarked on a new course, with respect to both technology and training. From mechanical instructions for field sampling and spraying based on centrally determined economic threshold levels, IPM shifted to more ecological principles. These different principles required a different approach to extension, as will be shown below. But we must first describe the institutional actors in the IPM National Program.

8. The institutional actors

The *National IPM Program* is a temporary structure that will be continued for a limited number of years. The first phase (1989-92) was financed by donations from USAID to BAPPENAS, the national planning agency, that were originally meant for pesticide subsidies. The second phase (1993-98) is sponsored by the World Bank. It is implemented with technical expertise from FAO.

The program is run by both expatriate and local experts. There are no senior counterparts in the traditional sense of the word. A Steering Committee, an Advisory Board, and a Working Group with members from various government institutions and universities were called into being to assist the program management. For management and curricula development purposes, special *secretariats* were established in Jakarta and Yogyakarta. The program works intensively within the country's existing framework, putting strong emphasis on creating linkages and contracting for specific jobs, such as curriculum development and training. In addition to training of extension staff and farmers, the program supports research activities such as a field laboratory in West Java focusing on white stemborer problems, a health impact study in a pesticide-intensive area in Central Java, insect habitat studies, studies on IPM in secondary food crops, and several training evaluation studies. A crash action was organized in West Java to control a severe white stemborer outbreak. Airplane spraying ordered by some senior officials could be prevented only at the last moment by promising mass action by school children and others to collect egg masses. The mass action was followed by a marked reduction in pest pressure, which boosted the national standing of the IPM Program considerably.

The IPM Program has continued to actively learn from its experience. A good example is the "threshold" for spraying. Starting from a *technical* damage count considering only the number of pests *per* rice hill or square meter, the threshold moved to a more sophisticated *economic* concept that weighed expected yield loss (in terms of damage (kg/ha) multiplied by price *per* kg) with estimated pest control costs. Applying this concept in farmer conditions, however, appeared complex and confusing, and therefore not workable. As a reaction to this, the IPM Program staff started to use the "*experience* threshold" that develops as farmers learn and experience and focuses on the procedure of decision making. In fact, the former entomologist of the program, Dr. Kevin Gallagher (1990), came to the conclusion that what mattered was that farmers made a sound decision, whatever the actual decision taken. Thus the program came full circle: from prescribing a concrete concept, the only thing that mattered in the end was the process. Meanwhile, however, it takes time for such learning experiences to penetrate the curricula, while staff who have been trained in previous concepts continue to propagate them.

At the regional level, the program operates from twelve *Field Training Facilities* (FTF). Existing in-service agricultural training centers in the eight main rice growing provinces were partly transformed into IPM FTFs. Primary trainers at the FTFs are the *Field Leaders I* (PL I, 21 in total) who are assisted by *Field Leaders II* (PL II, 129 in total), and by some training experts of the training centers in which the FTFs are hosted. Most of the Field Leaders belong to the group of pest observers upgraded in the crash IPM training in 1986 to become IPM master trainers. The development of a strong cadre of trainers is given high priority in the IPM Program, since it is the basic multiplier for the training of the millions of Indonesian rice farmers. Field Leaders I assisted in designing the final training curriculum and field guides.

Pest observers are civil servants at field level, whose numbers were doubled by INPRES 3/86, were used as the farmer trainers. In accordance with their original assignment, their basic task is still to monitor and report pest damage they have observed on fixed sample fields. But now they are also assigned as primary trainers in IPM. Having completed secondary agricultural school, all pest observers were trained in the crash IPM Program in 1986-87. Since then, some 1,120 pest observers have received 15 months special intensive IPM training through the National IPM Program and function as the IPM trainers at the Regional Extension Centers (REC) to train both farmers and extension staff, with each REC having two pest observers.

All officers intensively involved in the IPM Program (PL Is, PL IIs and pest observers) belong to the Directorate of Food Crop Protection, and *not* to the departments involved in the T&V extension system of NAEP (BIMAS Secretariat and Agricultural Service). However, the RECs, which fall under the responsibility of the Agricultural Service, are the basis from which all IPM training activities executed by the pest observers at the field level are organized, under some supervision of the senior staff there. It was obvious from the start that the village extension workers were not very suitable candidates for introducing IPM. They have many tasks, among which pest control extension is a relatively minor one. They are heavily involved in the T&V routine and in input distribution activities that conflict with the nature of IPM.

All staff involved in IPM training are temporarily assigned to the IPM Program and receive some topping up of their salaries. We shall return to this point when we discuss institutional development.

Rice farmers are obviously the intended beneficiaries of IPM training activities. At first sight, they seem similar in their cultivation practices. However, farmers appear to differ a great deal in terms of their use of inputs, farm size, tenure status, the type of off-farm jobs they engage in, the activity in farmer groups, and so on (Van de Fliert, 1993). The villages in which farmers live also show great diversity due to geographical and infra-structural isolation, leadership, history, and other factors. As described above, farmers are formally organized in farmer groups, which are officially used as a unit for selection of IPM training participants, but these groups are seldom active.

Vested interests in pesticide use are not immediately apparent beyond the agrochemical companies. But inputs are an enormous industry with a turnover valued at some US$1.5 billion *per* year. Involvement in this industry can be found in various sectors and levels, including salesmen, organizations such as the KUD, village officials, and extension workers. Influence of these interests on effects of IPM training and implementation have been observed to be substantial.

Policymakers are critically concerned with food security as the basis for political stability and continuity. Varying individual interests, however, sometimes result in a mixed support for the IPM Program. But increasingly, senior policymakers recognize the fact that the program has energized farmers, given them new confidence, and captured their imagination. Many consider this a welcome change from the existing farmer groups and extension approaches, which fail to engage farmers beyond token and formal participation.

Research institutes and Universities have only been marginally involved so far. The universities have trained the pest observers for a few months to provide them with a diploma, which allows them to advance in salary scale. Much greater involvement of research institutes and universities is planned for future activities.

9. Farmer behaviors supported by IPM

The IPM principles used in Indonesia are 1) grow a healthy crop; 2) observe the field weekly; 3) conserve natural enemies; and 4) farmers are IPM experts.

The IPM Program does not focus on transferring specific technologies or bits of information. Rather it seeks to capacitate farmers to make sound decisions. Based on the four main principles of IPM, the program emphasizes the following:

- focus on a *healthy crop*, tolerant to local pests and diseases, and able to compensate for pest damage;
- a *good knowledge of pests and their natural enemies*, not in terms of their (Latin) names, but in terms of their function in the rice ecosystem, what they do to plants and to each other at what stage of the crop. Such knowledge also includes the development stages of a pest and their recognition. This knowledge is expected to be updated and improved by farmers' own observation and experimentation, and by farmer-to-farmer exchange of experience;
- *regular and systematic observation* of the field,

using systematic procedures (random selection of sample rice hills) to assess the occurrence of pests and natural enemies in relation to the crop's development stage;

- *sound decision making* (whatever the decision) and discussion with other farmers about such decisions;

- *experimentation* with planting times, varieties, soil cultivation practices, fertilization, rotations, and biological controls for their effect on pest populations;

- *use of relevant, science-based knowledge*, such as the work at the IRRI (the International Rice Research Institute) on the regenerative capacities of rice varieties after pest damage, or the work of the program's own experiments, *e.g.*, on parasites in the egg masses of white stemborers.

It is clear that with such priorities, farmers' own expertise and mastery is fostered rather than only their adoption of external information. It is remarkable, in this respect, that, when asked about advantages of IPM, farmers tend to mention not only the reduction in costs of production, but also the pride in their new-found expertise.

10. IPM's approach to farmer training

It is obvious that promoting the behaviors mentioned requires an extension approach that differs considerably from passing on chewable "bites" of ready-made information. The basis for the training approach developed in the Indonesian IPM Program is Non-Formal Education or NFE (Dilts, 1983; Dilts, 1990, Frith, 1983). NFE is a "learner-centered" discovery process. It seeks to empower people to actively solve "living" problems by fostering participation, self-confidence, dialogue, joint decision making, and self-determination. Group dynamics exercises are an important part of this approach. In all, this approach is totally different from the old-style "delivery of technology" conceptualization.

The IPM Program's training program comprised the following key ingredients:

- An IPM Farmer Field School (FFS) consisting of a training group of 25 farmers, selected either from one farmer group (*Kelompok tani*), or across such groups within one village;

- During the training, farmers work in small subgroups of five, the optimal size according to NFE experience worldwide;

- Training starts with a "ballot box" pretest of knowledge and ends with a post-test. The tests, which have a multiple-choice character, are done in the field and about field problems. The scores of the tests, which are fairly meaningless in themselves, are a great motivational device for the participants, and give an important diagnosis on trainees' relative ability to the trainers;

- The Farmer Field School lasts for the main part of an entire rice growing season so as to follow all stages of crop development. The school meets once a week for ten to twelve weeks;

- Each Farmer Field School has one training field, divided into two plots: one IPM managed field, and one field with the package recommended by the Agriculture Service including one preventive granular pesticide application;

- During the training, lecturing is hardly used. The trainers do not allow themselves to be forced into the role of expert. They do not answer questions directly, but try to make farmers think for themselves instead. "What did you find?" "What did it do?" "What do you think?" This is called the "*Apa ini*?" principle, meaning literally "What is this?" Answering a question directly is considered a lost opportunity for learning;

- The field school meets somewhere in or close to the field under a tree or in a small shack that provides some shade;

- The main activity, the first in the morning, is to go into the demonstration fields in groups of five and observe sample rice hills, usually chosen randomly along a diagonal across the field. Notes are made of insects, spiders, damage symptoms, weeds, and diseases, observed on each hill. The stage of the plant is carefully observed, as is the weather condition. Interesting insects and other creatures are caught and placed in small plastic bags.

- Drawings of what was observed are made in the subgroups, the agroecosystem analysis. On large sheets of cheap newsprint fixed to a sheet of plywood, using different colored crayons, farmers draw the rice plant at its present stage of growth, together with pests and natural enemies occurring on it. A conclusion about the status of the crop and possible control measures is drawn by the five members together and written down on the paper;

- The subgroups' agroecosystem analyses are presented to the whole field school group. The conclusions drawn from the field observation with respect to pest control are discussed in the entire group. The field has become the main training material and farmers' own observations the source of knowledge for the group;

- During each session, special subjects are introduced. Their training provided the pest observers with a substantial repertoire of modules carefully developed to avoid lecturing. Special topics relate to occurring field problems, such as rat population growth, effects of pesticides on natural enemies, and life cycles of rice field inhabitants;

- Socio-dynamic exercises enliven the field school and create a strong sense of belonging to the school;

- Farmers often keep an "insect zoo", plastic netting around four bamboo poles set around a rice plant. Inside, various pests and predators are introduced, and watched by farmers. Through their own experiments and observations, farmers gain ecological knowledge;

- Active members of groups are encouraged to train other groups. This farmer-to-farmer dissemination is an important strategy for mass replication;

- Farmers participating in the IPM field school receive a compensation of Rp 1,000 (approximately US$ 0.50) *per* day from the program to remunerate possible loss of income while spending time in training. Many groups use these moneys for buying caps and T-shirts, decorated with the emblem of the program and their farmer group name, visibly increasing group spirits. Some groups also use (a part of) the compensation to go on excursions, for instance to experiment stations or training centers.

Senior visitors to the field schools marvel at what is happening. Here are farmers and some village officials, the lowliest ranked people on the bureaucratic hierarchy, actively and intelligently discussing their problems, drawing often very accomplished and accurate pictures of various insects, speaking in front of others (including such visitors as the Minister of Agriculture) and making considered decisions about pest control.

In all, the IPM Farmer Field School exemplifies the new type of extension that seems consistent with facilitating more sustainable forms of agriculture. But we must keep in mind that, so far, the Field School approach has not been tested in isolated villages and has reached mainly the better informed and more affluent farmers (Van de Fliert, 1993). If there is one "law" in extension science, it is that knowledge ends up where there is most of it already (Röling, 1988). In future, the Program will have to pay attention to the selection process to solve this problem, and where necessary adapt the training approach and contents.

11. The training of trainers

The type of farmer training we have discussed requires different staff training. After the fiasco with the crash IPM training, T&V style, immediately following the 1986 Presidential Decree, the National IPM Program opted for a much more fundamental and penetrating approach consistent with the needs of IPM. The training of trainers, as well as extension worker training, is more or less the same as farmer training. The same basic elements, such as field observation for agroecosystem analysis, recur at all three levels.

The NFE approach to staff training began in earnest in July, 1989 with the training of trainers. Twenty-one PL Is (formerly the IPM master trainers), fifteen pest observer coordinators, five heads of Pest Control Laboratories, and ten trainers from Agricultural In-Service Training Centres were thoroughly trained to form the basic IPM trainer cadre.

An important key to the success of the IPM Program obviously lies in pest observer training. As we have seen, the program opted for the pest observers as field level IPM trainers, since the village extension workers were not very suitable candidates for introducing IPM. Pest observer training basically uses the same principles as farmer training, as described below:

- training takes 15 months and consists of the following components:
  - rice IPM induction training (3.5 months);
  - extension training in IPM farmer field schools(3.5 months);
  - dry secondary food crops IPM training (3.5 months);
  - a diploma course at the university (4.5 months), which allows them to be promoted in the formal system.

- One training group consists of fifty people, divided into subgroups of five each;

- Rice and secondary food crop IPM training takes place at the Field Training Facilities (FTFs), where the pest observers grow their own crops. They have to become farmers first before they can face farmers in a position as trainers;

- The training curriculum is completely field-oriented. The "*Apa ini?*" principle is the basis for learning. Field problems discovered in the practice fields become topics for discussion. Carefully designed field experiments, such as systematically comparing varieties, fertilizer treatments, variations in pesticide treatments, and a range of special topics (modules to be used in farmer training) are introduced and discussed;

- Extension training takes place in the home areas of the pest observers where they conduct four IPM farmer field schools each during one season. In this training, two village extension workers *per* pest observer are trained in IPM on-the-job;

- Field Leaders I and II facilitate the FTF trainings, and supervise the pest observer training in the field.

The goal of training the pest observers is to make them confident IPM experts, instill an attitude of self-learning through experimentation, and develop a cadre of effective trainers of farmers and extension workers. Since 'the methods we learn from are the methods we fall back on when we teach others' (Pontius, 1990), the methods used during pest observer training are those they are expected to use with farmers. During their training, pest observers work in their fields every morning, a rare event for civil servants. Special topics are developed and presented into a set of modules that pest observers feel confident to handle with farmers or extension workers. The training is supported by elaborate manuals.

During their training, one pest observer has to choose two village extension workers from his REC to form a team for farmer training. The village extension workers are given a one-week introductory training at the FTF in which they are acquainted with the principles of IPM and with the farmer field school training approach. The trainer teams formulate work plans for farmer training. One team conducts two farmer field schools, which implies four field schools *per* pest observer. During the implementation of the farmer field school, the pest observer is the main facilitator, whereas the village extension worker assists where necessary and, at the same time, learns on-the-job to become IPM facilitator.

With this setup, one training cycle, which takes about a year, at one FTF delivers 50 trained pest observers, 100 village extension workers, and 5,000 field school farmers. This process has continued over more than two years now at ten FTFs, and at two additional FTFs that were opened in 1992. In all, by May 1992 about 1,120 pest observers and 4,700 village extension workers were trained following a Non-formal Education approach, resulting in over 200,000 trained farmers.[5] This does not include farmers trained through farmer-to-farmer training.

When pest observers have completed their one-year IPM training at the FTF and university, they go back to their RECs.[6] Partly, they have to pick up their work recording pest infestation in the REC work area, but for the other part they are now the IPM trainers. Their first job is to organize a season-long IPM Field School for all extension workers at the REC. After this training, the extension workers are supposed to organize Farmer Field Schools in their work areas, assisted by the pest observers.

12. The institutional framework

Given the nature of the farmer behaviors promoted by the National IPM Program, and given the approach to farmer and staff training it developed, it stands to reason to expect a different institutional setup than the one required to field an army of officials who promote blanket recommendations and technology packages. IPM seems to require decentralized teams of trained staff, capable of autonomous, locality-specific decision making, based on local monitoring and experimentation, and rooted in active farmer participation and control. In fact, farmer organization is seen as a necessary condition for program sustainability (Dilts, pers. comm.).

The institutional framework required to guarantee continuation and sustainability of what has been achieved so far is still emergent, although quite a lot has happened, especially in the last two years.

One important issue is whether a decentralized system as described above can function in such a hierarchical system as Indonesia's public sector. For example, does the "system" allow the payment of salaries commensurate with the high level of training required of decentralized IPM staff? A decentralized setup might require local funding. Some interesting developments can be reported with respect to such questions. The new National Extension Project to be funded by the World Bank is to be based on the IPM farmer field school model. In other words, the Program seems to have inspired a basic shift in thinking about investment in, and design of extension. No doubt this major shift has to do with the IPM Program's capacity to capture farmers' imagination and inspire them. About 100 seminars have been organized at which farmers give 5 hour presentations to local officials and officers. Within the Program, considerable advance has been made with setting up a planning and management network at the subdistrict level, and in generating funds from local governments.

A second issue is science linkage. So far, the program has relied heavily on the special input of expatriate specialists and their connections with international research. In future, local experimentation and decentralized expertise must have easy access to sources of scientific knowledge and research capacity.

Thirdly, reaching the mass of Indonesian rice farmers still requires considerable attention. So far, the farmers reached have been the usual relatively elite farmers. The question is how to rapidly expand the IPM practices to the relatively less endowed. The program has looked for a solution in three directions.

In the first place, it is experimenting with ways of involving the regular extension staff in IPM training. As we have seen, this is not an easy matter. This staff cannot be trained as thoroughly as the pest observers. Yet they have much to unlearn. They work on the basis of a transfer of technology model and rely on the delivery of packages of inputs as the basic technology. Many of them benefit monetarily from input distribution to top up their insufficient salaries. Some evidence exists that village level extension workers can actively undo the effect of IPM Farmer Field School training at the village level (Van de Fliert, 1993).

In the second place, the program has experimented with farmer-to-farmer communication. In some cases, the members of Farmer Field Schools became so enthusiastic that they spontaneously started field schools for other farmers. Farmer-to-farmer training seems a very promising route to large scale multiplication. The program actively assists such groups by providing the required inputs. At present, several alternative models for impact multiplication are being developed (Van de Fliert *et al.*, in press).

In the third place, the program is groping for methods to generate "social energy" (*e.g.*, Uphoff, 1992), the capacity for change that emerges when people gain new perspectives and an expectation that things can improve. In that sense, IPM is considered as a dynamic, emergent movement, fostered by the energy of activism and the excitement of learning, and characterized by different stages, with specific sets of institutions involved at each stage.

We have described in some detail the creation of the policy context for the IPM Program, and the first

IPM training efforts through the T&V system, which the program needed to learn its way to a facilitation model that seems consistent with the needs of IPM. As it matures, the program develops in terms of identifying approaches and developing a cadre of trained trainers, as well as in terms of establishing a model for policy that is gaining acceptance. The next challenge is to develop institutional frameworks that will allow the effects to be sustained. It might well lose some of its activist energy but hopefully will not be diluted with bureaucratic and transfer thinking to a point where it loses its consistency and character as a post-Green Revolution "new wave". Much will depend on the Program's ability to enroll farmers' and their organizations.

13. Conclusions

The National IPM Program in Indonesia provides a unique case study of an effort to promote more sustainable agricultural practices. It has experimented with alternatives that we cannot ignore. What makes it particularly interesting from an extension science point of view is that it has deliberately tried to develop adult education approaches that fit the requirements of IPM. Few projects or program have that capacity. The Program has experimented on a scale that goes beyond the usual pilot project, and done so within the ambiance of government institutions. It allows some observations that can help shape the perspectives of policy makers, research and extension administrators and voters as they try to learn their way to more sustainable futures.

1. The national crisis and the resulting regulatory policy framework provided a crucial context for the extension program. The IPM Program with its emphasis on Non-formal Education cannot be imagined without the conditions created by the 1986 Presidential Decree (including measures such as the ban of broad-spectrum pesticides, removal of subsidies, *etc.*). It seems likely that an educational effort alone could not break through vested interests and market-based incentive structures without the deployment of such policy instruments.

2. An elaborate farmer training effort was considered necessary, in addition to the regulatory measures. As we have seen, these measures were, in themselves, sufficient to reduce the use of pesticides, reduce the threat to food security and make farming more cost-effective. The IPM Program gives the following grounds for the elaborate farmer training program:

- The conventional high external input approach to agriculture is heavily ingrained in the national system and can be expected to have considerable momentum. The pesticide industry and the input distribution apparatus, including extension workers who support their income through pesticide sales, can be expected to exert continuous pressure on farmers to use pesticides, replacing banned substances with permitted ones. Evidence to this effect was found in terms of promotion of the relatively expensive carbofuran granules permitted by INPRES 3/86 (Van de Fliert, 1993). Only a critically aware farming populace can provide the necessary counterpressure;
- Local outbreaks can easily be used to scare farmers and local officials into massive use of pesticides and to undermine IPM. The IPM Program has experience with organizing collective activities to prevent unnecessary pesticide use, even in outbreak situations;
- An impact study conducted for the IPM Program in 1991 among over 2,000 IPM Field School graduates in five provinces showed that trained farmers used 50% fewer pesticides than untrained ones, especially with respect to the banned substances (Pincus, 1991);
- However, the main reason is that sustainable agriculture, with its reliance on knowledge-intensive local agroecosystem management, requires that farmers are "experts" in their own fields, capable of observation, experimentation, considered decision making and joint deliberation.

3. The failure of the crash program to muster conventional extension for IPM training suggests that introducing sustainable agricultural practices with their reliance on observation, farmer expertise, and so on, is inconsistent with a technology transfer approach to extension. A similar failure of conventional extension has been recorded by Agudelo and Kaimowitz (1989) for an effort to reduce input use in irrigated rice in Colombia. The Program has deliberately developed an alternative non-formal education approach which we could call the "facilitation model" (*e.g.* Woodhill *et al.*, 1992; Röling, 1993a). Instead of transferring ready-made packages of technology and blanket recommendations, this approach seeks to enhance the capacity of farmers to learn, to make sense of their experience, and to take considered decisions. The methods used emphasize experiential leaning and participation. Farmers' new-found sense of being knowledgeable seems to have empowering and energizing effects.

4. The IPM Program's experience suggests that a different extension model has important implications for investment in extension, the design of extension institutions, the conception of research-extension linkages, the deployment of other policy instruments alongside extension, and for staff training. These implications seem to merit careful, further comparative analysis. It is heartening that the next phase of the National Agricultural Extension Project in Indonesia has taken the IPM Farmer Field School as its basic extension model. It can only be hoped that such alternatives will be taken into account also in other investments the Bank makes in agricultural extension.

14. Suggestions for further research

The IPM Program suggests some interesting questions for further research.

(1) The program obviously relies on activist energy for its initial effect. The question is whether such initial momentum can be incorporated into regular government routines without compromising its essence. The linear Technology Transfer model has a much better fit to the top-down bureaucratic structure than the Non-Formal Education approach, which seems more consistent with the needs of IPM. An interesting question for further research concerns the institutional arrangements, including farmer organizations, financial structures, and checks and balances, that allow the type of decentralized and participatory facilitation that the introduction of more sustainable practices seems to require.

(2) An intrinsic aspect of sustainable agriculture seems to be the need for farmers to form platforms for collective decision and action that are consistent with the level of the agroecosystem to be managed in a sustainable manner. A typical example is rat control for which individual measures are not effective (Van de Fliert *et al.*, 1993). A similar observation can be made with respect to the use of parasitoides to control pest populations (Van Keulen and Schönherr, 1992). However, communal action is beset with problems, such as social dilemmas. Platforms for farmer decision making that are commensurate with ecosystems that need to be managed for sustainable natural resource management, and the facilitation of such platforms, are an exciting area of extension research.

(3) Farmer learning processes involved in accepting more sustainable forms of agriculture are insufficiently understood. If, as IPM's experience suggests, acceptance of more sustainable practices is not so much a question of adopting an innovation, but of a "paradigm shift" requiring a learning process, then we need a much greater understanding of the learning path, the changing perception of risk and insecurity during that path, the way progress along the path is made visible, *etc*.

(4) The most important question that emerges, however, is whether introducing more sustainable forms of agriculture indeed requires a different approach to extension as the IPM experience suggests. Answering this question requires considerable comparative research. So far, the cases studied seem to suggest that an alternative approach is indeed required (*e.g.*, Röling, 1993c).

Notes

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2. The authors wish to express their gratitude to the Indonesian Government for the opportunity that the National IPM Program provided to be involved in a significant and meaningful activity. It has allowed them to engage in a great deal of "cognitive remapping", and constituted an unforgettable and hope-giving experience. They are particularly grateful to Dr. Russel Dilts, the Program's inspired and dynamically unconventional Team Leader, for his guidance, trust, and hospitality. Extension science is largely practice-informed theory. The creative moment is not so much in writing it down as in developing the practical approaches on which it is based.

3. We would like to emphasize the difference between (1) the policy measures such as banning the use of 57 pesticides by law, and (2) the IPM Program, which focuses on adult education as its key "instrument" for change. The ban itself has led to a strong reduction in the frequency of pesticide applications. However, the adult education effort is considered essential for ensuring sustained responsible pest control decisions by farmers.

4. The FAO "Inter-country Program for the Development and Application of Integrated Pest Control in Rice in South and Southeast Asia" started with a pilot IPM (training) program in 1978-80 in the Philippines. In the next decade, funded by the governments of The Netherlands, Australia and The Arabic Gulf Fund, the program expanded to nine participating countries in South and Southeast Asia, where it initiated IPM training and research activities, and supported national program. Presently, six more Asian nations are interested in joining the program.

5. In addition to the main training model of the program described here, in which village extension workers are trained as apprentices during the Farmer Field School season, various other models were developed and tried out in order to expand IPM to more extension staff and farmers (Van de Fliert *et al.*, in prep.). Although organization is different, all models depart from the Farmer Field School design.

6. Since early 1992, the structure of the extension service has changed. RECs were abolished as centers of all extension activities. The buildings still house the routine staff training, but village extension workers and pest observers moved to the subdistrict office (one REC work area consists of around three subdistricts). Senior extension

worker positions at the REC were abolished. (Sub)district extension officers are now involved in the supervision of field work. The changed structure has no major implications for the described tasks of the pest observers trained in IPM.

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