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Beyond the Farmer Field School: IPM and Empowerment in Indonesia

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To many scientists and researchers, Integrated Pest Management (IPM) is just about pests (Dilts, 1994). Yet this overlooks the important role IPM can play in human resource development. Whilst insect pests are naturally important entry points (Matteson et al., 1994; Ooi et al., 1991), these open the door to a more important aspect of IPM, that of human resource development (Dilts and Simon Hate, 1996). This paper attempts to reaffirm the importance of farmer participation in IPM (Oka, 1997). Using three detailed case studies from Indonesia, it demonstrates that farmers have the desire and ability to solve problems and improve their productivity when given the opportunity to do so.

The Green Revolution is largely responsible for the perception that insecticides are modern day imperatives. The occasional yet devastating effects of locusts and other insect pests and their links to famine have provided fuel for this. Hence, insecticides were packaged into the Green Revolution. This led to many pesticide subsidy schemes which resulted in widespread application of insecticides by farmers. The result was a false belief that without insecticides there would be complete crop loss. Many farmers in developing economies were told only about insect pests and the job of the extension service was to provide recommendations on what insecticides to use. Such a biased approach to pest management led to secondary and new pest outbreaks (Conway, 1972), environmental pollution (Lim, 1990) and increasing health hazards to farmers and consumers (Misa Kishi et al., 1995; Murphy et al., 1998). Despite many of these problems being highlighted, the approach by the industry has changed little over the years, with the proponents of chemical control becoming more sophisticated in promoting the use of hazardous chemical insecticides (Vorley, 1992). Hence, the promotion of messages of when to spray and when not to spray continue to limit farmers' involvement in pest management to a passive role (Bato et al., 1992; Heong and Escalada, 1997).

IPM in Indonesia

The main goal of the Food and Agriculture Organisation's (FAO) Programme for Community IPM in Asia is to involve farmers actively in the development of IPM (Bartlett, 1998). IPM by farmers has progressed particularly well in Indonesia (Fliert et al., 1995). It started as a response to regular outbreaks of the Brown Planthopper, *Nilaparvata lugens*, despite widespread use of insecticides. The government had to ban 56 insecticides from rice fields and instituted an extensive farmer education programme (Wardhani, 1992). From this the Farmer Field School (FFS) approach emerged (Kenmore, 1996; Dilts and Simon Hate, 1996; Matteson, 1996), which consisted of an education programme using the rice fields as classrooms and field laboratories. The Indonesian government secured a World Bank loan to fund IPM implementation based on farmer education in FFSs (Oka, 1997). To date more than a million farmers have been educated in FFSs in six main rice growing provinces of Indonesia. The challenge now is in ensuring quality of IPM education among farmers.

The IPM learning process starts with the Farmer Field School. Through these schools, skills are built for making decisions and taking action based on an open discussion of ideas. These decisions form the basis for hypotheses which are tested in the field laboratory. The analytical processes involved enhance farmers' capacities to examine the conditions in which they live and work. Having completed their FFS, participants are able to take decisions about actions which will improve their situation. This is by no means the end of IPM; rather, it is the beginning, because the skills learnt can allow farmers to continue and sustain IPM activities, and also apply them to many situations in their daily lives. One of the follow-up activities of IPM implementation in the FAO Programme for IPM in Rice is the development of Action Research, which builds on and further develops these skills. This paper describes some of the achievements of this approach.

White Stemborers in Indramayu

When Mr. Arief Hakim, an IPM facilitator from the FAO Technical Support Team, first arrived at Kalensari village in the district of Indramayu (in the coastal rice bowl of West Java) in mid-1995, he was welcomed as a visitor. However, when he started discussing the possibility of studying the White Stemborer, his hosts were less than enthusiastic. They had met many visitors who wanted to collect data and then disappeared. Farmers assumed that such researchers were only interested in collecting data for their own use. However, Arief managed to convince Kalensari farmers that he wanted to learn from them.

It was clear from the beginning that farmers did not understand the biology of the White Stemborer, despite long association with the insect (see Kalshoven, 1981). Almost annually, the White Stemborer would occur in the first season following a three month drought. The farmers reported often seeing swarms of them in this first season. To get farmers interested in this phenomenon, Arief asked them what they did when they found large numbers of the moths. The replies were unanimous; the moths would be sprayed. However, they were puzzled to still find egg masses in

nursery beds. They suggested that this could be due to moths arriving from surrounding areas and possibly due to poor distribution of sprays.

Arief suggested that farmers could carry out studies to determine the effects of insecticides. So, in July 1995, some White Stemborer moths were collected from the fields and farmers sprayed them with insecticides. To their surprise, the moths spawned eggs before they died. Farmers then concluded that spraying insecticides did not prevent egg laying.

An action research facility (ARF) was developed to help farmers to understand basic ecological principles (FAO ICP, 1996). Farmers who had been earlier participants in a 1990 Farmer Field School (FFS) participated in this ARF. Arief helped them identify what they were experiencing in the agroecosystem, discussed what they usually did when confronted by such an experience, what the results of these actions were and why they think these results occurred. These questions led to a range of studies to explore why these results occurred (Table 1).

In many ways, ARF activities resembled those in a FFS. Regular meetings were held, farmers went into the field to make observations, there were 25 farmers participating as researchers and study plots were established so that farmers could conduct experiments and collect data. The role of the facilitator was not to plan and conduct experiments for farmers. Instead it was to help in experiment design and implementation.

In another study, farmers evaluated an insecticide (carbofuran) coated on sand particles and applied in the seedbed. Results were variable, depending on the time of oviposition of the eggs. Hence, farmers realised that application of carbofuran did not guarantee an insect-free nursery. Armed with this information, farmers went further, exploring why there were still outbreaks despite spraying insecticides on egg masses. They collected freshly laid egg masses and sprayed these using the recommended dosage. Farmers noticed that after about a week, healthy larvae emerged. The results convinced farmers that spraying insecticides really did not stop an outbreak. They had to look for another approach and subscribed to the principle that the more they understood the biology and ecology of the Stemborer, the greater the potential for management.

The next study concerned learning about the origin of early season flights. Farmers suspected that the moths came from the fields and decided to survey rice stubbles left in the field from the previous season. To their amazement, they found live larvae within some of the stubbles. Discussions with resource persons helped them understand the concept of insect aestivation (a form of hibernation during adverse weather conditions), observed by Goot (1925). This discovery led to different experiments to kill off the aestivating larvae. This showed that burning and flooding did not kill many larvae, and that the best approach was to remove egg masses. They organised a local campaign to do this. This campaign proved successful, as the incidence of Stemborers in the locality was about 5% compared to neighbouring areas which had about 25% bored tillers due to prophylactic spraying.

Continued discussion among farmers and resource persons led to the design of experiments for avoiding the peak flights of the Stemborer. Farmers carried out studies to understand when the stemborers took flight. They were able to duplicate Dammerman's (1915) study with light traps, using them to monitor Stemborers'

flights. Farmers also learnt the role of water in breaking aestivation. Combining this information, farmers set up a strategy to 'forecast' peak flights and organised other farmers in their villages to only plant nursery beds after peak flights.

Table 1: Farmer-led hypotheses and experiments

What farmers observed	Previous actions of farmers	Results	Why did this happen?	Farmers' study	What did farmers learn?
At the beginning of the season the number of moths flying around is high	Moths were sprayed	The moths died, but there were still egg masses in the nursery beds	Flights came from other places. Spray of insecticides was not even	Spray moths in controlled conditions	The moths died, but still were able to spawn eggs
	Put carbofuran on the nursery bed	Still had stemborer outbreaks		Under controlled conditions put carbofuran on nursery beds	Using the legal rates of dosage, results were variable
There are lots of white stemborer egg masses in the nursery beds	Spray insecticides on the egg masses	Still had outbreaks	Insecticide adulterated. Egg masses protected by felt like hairs.	Apply insecticides directly on egg masses	The eggs still hatched
Flights of moths at beginning of rainy season observed but origin unknown	Nothing		Do not know	Survey rice stubble in the fields during dry season to look for larvae	Stemborer larvae found alive in rice stubble. An average of 1.4 larvae/sq. m.

An important feature of the ARF is continuous study and discovery. One discovery leads to other studies and even when farmers have developed campaigns, they continue to carry out studies and increase their understanding of the agroecosystem.

That farmers involved in the action research helped solved a field problem that has been known by researchers since the 1930s, is an unexpected result from an effort to promote science amongst rice farmers. Prevailing conventional wisdom was that if researchers cannot implement a control programme, there is little hope that farmers can do so! This example reveals the need for scientists to review their role in helping farmers solve problems (Matteson, 1996; Pretty, 1995).

Baiting the Rice Ear Bug

The village of Sambon in Central Java depends on rice cultivation for its survival. This village is blessed with a year-round supply of water and is situated at the foot of Mount Merapi, a well known active volcano. Like most parts of Java, farmers tend small plots of land and in Sambon, farmers often cultivate three crops per year.

Mr Hartjahyo Ariawan (Wawan), an IPM facilitator from the FAO Technical Support Team, moved to Sambon to work with farmers to understand and manage tungro, a severe rice virus. Farmers in the village were so enthusiastic with their new-found skills that they asked him to help them understand the Rice Ear Bug. The Rice Ear Bug, *Leptocorisa oratorius*, damages the flowers and milky grains of the rice plant, and can lead to huge losses. Traditionally, farmers put out bait to attract the bugs so that they could then be killed. However, these traditional methods have been neglected in the move to modernise agriculture. Wawan was excited when farmers explained that their ancestors used rotting animal parts or even chicken droppings to attract *Leptocorisa*, and that they wanted to find out if this really worked. After several discussions, a plan was drawn up by the farmers to evaluate the different baits which their ancestors used.

To start with, farmers developed cheap traps using 1.5 litre drinking water bottles. These were filled with different animal-based lures to test their ability to attract the Rice Ear Bug. The most useful lures included putrescent crabs, putrescent toads, putrescent prawn or prawn paste, droppings of chicken, and putrescent internal organs (primarily intestines) of chicken. Results of these preliminary studies led to further questions, such as which bait was consistently better and for how long? are both sexes equally attracted? and more importantly, does trapping reduce damage to developing grains?

A follow-up study was initiated by the farmers to answer these questions. A field belonging to a farmer involved in the study was divided into 5m squares. Traps made from old water bottles were tied to bamboo poles about 2m high. When sunk into the mud, the trap stood just above the flowering parts of the rice plant. Six treatments were randomly arranged within the subplots. This allowed farmers to learn how randomised distribution can eliminate the bias of the trap's position in the field.

Baited traps were set up in the field soon after flowering. Twice a day, the traps would be examined and trapped *L. oratorius* were removed, counted and sexed. The study continued for 10 days.

This study showed that chicken droppings were most attractive to *L. oratorius* (Table 2), followed by putrescent crabs and putrescent chicken intestines. However, the majority of the bugs caught were males and further studies were planned to understand whether the removal of males would affect populations. At the time of writing, farmers were unable to study this as the populations of *L. oratorius* were very low. However, from this experience, they learnt to appreciate the use of baits to monitor seasonal occurrence of the bug, hence avoiding the expensive prophylactic application of chemical insecticides.

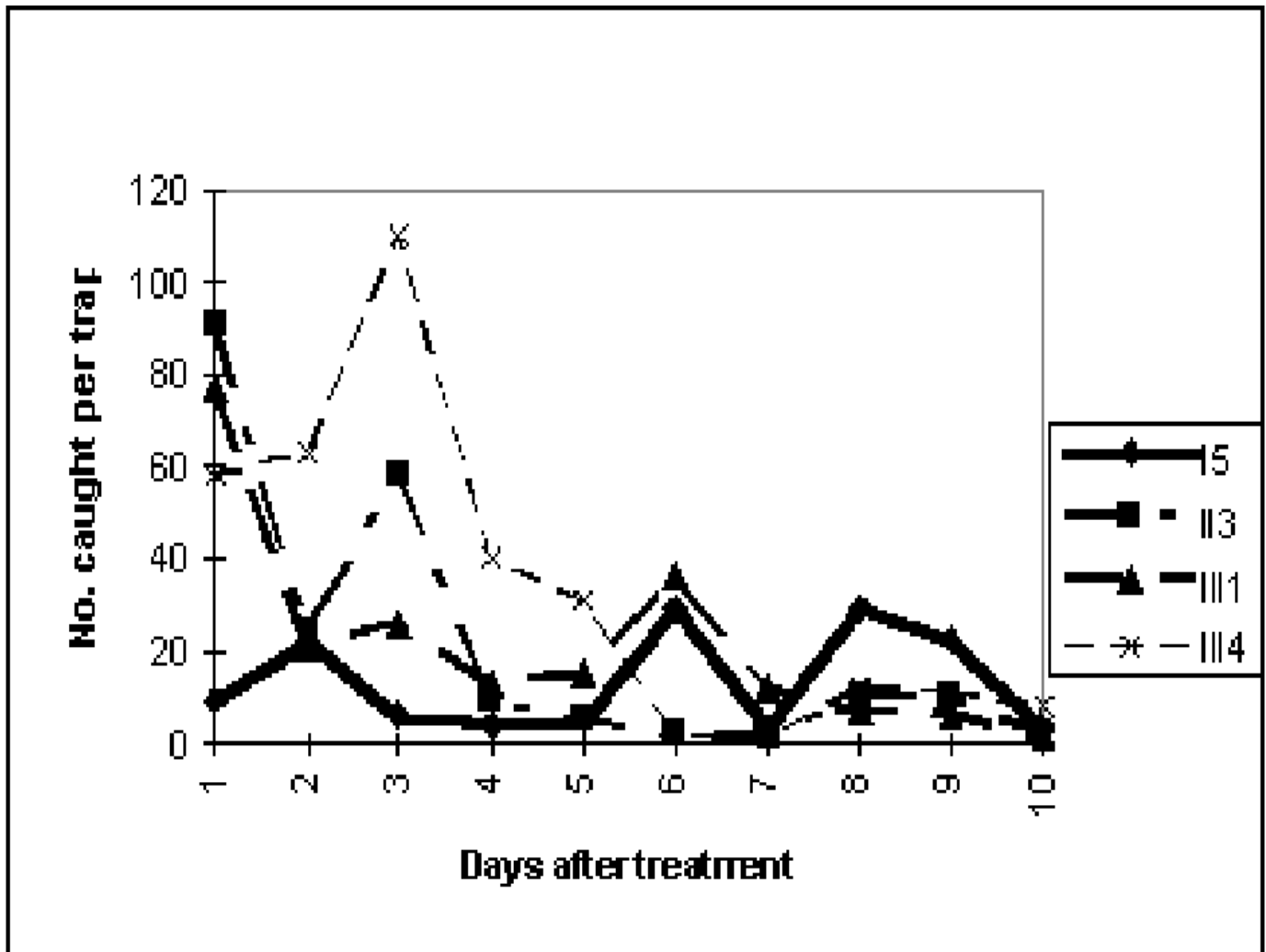
Table 2: Analysis of success of traditional baits in trapping *Leptocorisa* *

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Days after	Treatments																	
Setting up	No bait			Rotting crabs			Rotting toads			Fermenting prawns			Chicken droppings			Rotting intestines		
Study ^{AA}	M	F	% M	M	F	% M	M	F	% M	M	F	% M	M	F	% M	M	F	% M
1	4	0	100	134	1	99.3	7	0	100	19	0	100	235	0	100	13	0	100
2	22	0	100	112	0	100	26	0	100	4	0	100	130	0	100	15	0	100
3	9	0	100	58	2	96.7	54	0	100	11	0	100	200	0	100	48	0	100
4	8	1	88.9	17	2	89.5	19	4	82.6	8	0	100	66	2	97.1	39	2	95.1
5	1	1	50	18	2	90	39	2	95.1	25	1	96.2	56	3	94.9	14	1	93.3
6	7	0	100	15	0	100	12	1	92.3	11	1	91.7	69	0	100	12	1	92.3
7	2	0	100	20	1	95.2	24	3	88.9	18	0	100	17	1	94.4	17	1	94.4
8	1	0	100	28	0	100	11	0	100	9	1	90	58	0	100	41	0	100
9	0	0	0	14	1	93.3	16	1	94.1	11	0	100	49	1	98	14	1	93.3
10	0	0	0	12	0	100	6	2	75	2	0	100	14	0	100	19	2	90.5
Total	54	2	96.4	428	9	97.9	214	13	94.3	118	3	97.5	894	7	99.2	232	8	96.7
* - Total of four (4) replicates																		

Farmers studied data from chicken droppings bait and found that there was a decline in bugs caught as the grains matured (Figure 1). *L. oratorius* catches peaked in the first three days and declined over the next seven days. They concluded that there were fewer *L. oratorius* after the grains hardened. There is much variation in the four replicates (I5, II3, III1 and III4), confirming the need to have replications to show that trap catches are not dependent on the position of the traps in the field (I5 and III 1 are at the edges while II3 and III4 were in the middle).

Besides learning more about the Rice Ear Bug and its ecology, farmers were able to satisfy their curiosity about traditional control measures. The skills learnt in setting up experiments helped them become more confident about carrying out field experimentation.

Figure 1: Catches of male *Leptocoris* sp. in traps baited with chicken droppings



Dragonflies in Rice Fields

Whilst the first two case studies showed how farmers can rediscover scientific evidence and evaluate traditional approaches to pest management to improve their farming success, the third case study demonstrates that farmers are also capable of their own spontaneous research.

Pak Oyo is a respected farmer in his community and attended a Farmer Field School two years ago. At the FFS he learnt about natural enemies that keep rice herbivores in check (Ooi, 1996). Following field observations and experiments, he better appreciated the role of predators. Pak Oyo was so inspired by what he learnt that he decided to enrol as a farmer trainer, and the training developed his capacity for innovation and creativity. This further inspired him to look seriously at rice ecology.

Pak Oyo has a farm in his village of Buah Dua, a village dependent on rice cultivation for its economy. One morning three seasons ago (in March 1996), while caring for a rice nursery, he saw a large number of dragonflies hovering over the young rice seedlings. Pak Oyo remembered from his training and the FFS that dragonflies are predators. Indeed, he observed some dragonflies capturing Brown Planthoppers (BPH) as these flew from the nursery as Pak Oyo worked in it. He was excited by what he saw. Looking around, he noticed some dragonflies resting on bamboo markers next to the nursery.

Pak Oyo thought hard and long about what he had seen in the nursery. It dawned upon him that if dragonflies could be encouraged to stay in the rice field, they would protect his crop from insects. He was concerned about the normal practice of spraying insecticides to prevent BPH outbreaks. Pak Oyo was convinced that spraying insecticides had led to several outbreaks of this insect in the village. Encouraging dragonflies in the field could possibly reduce the number of BPH coming into and flying out of the field.

He planned a small experiment to see if dragonflies could be encouraged to stay in a field planted with markers. Initially he used only six bamboo markers placed around the field for two weeks. Regular observations showed that dragonflies frequently rested on the markers and this encouraged Pak Oyo to expand this study. He placed more bamboo markers all around his field and he noticed that throughout the season there was no build-up of BPH in his crop, whereas neighbouring fields subjected to insecticide sprays had large populations of BPH. He talked to his friends in the village about his results and they decided to join him in the experiment and the topic was included in a FFS organised by Pak Oyo. In the next two seasons, farmers who placed bamboo markers in their fields did not have any problem with BPH. In the coming season (1997/98), up to 40 ha of rice fields will be planted with bamboo markers and farmers are confident that they will not need to apply insecticides.

Dragonflies are familiar insects in the community. Children play with captured adults by tying thread to the abdomen and watching them attempt to fly away. Children were warned about wetting the bed for if they continue to do so, the parents will catch a large dragonfly (possibly *Orthethrum sabina*) which will bite their navel. According to farmers in the village, this is a successful way to stop children from wetting their beds.

Rice farmers knew the life cycle of the dragonflies in the rice field. Part of this came from their greater interest in the insect during FFS. However, most of the information came from their gastronomic knowledge. Apparently, larvae of dragonflies (kini-kini) are eaten as food, particularly by women. These are collected when women weed the rice field. Kini-kini are considered delicacies by the women folk. These are either fried or mixed with herbs and steamed wrapped in a banana leaf.

There appeared to be a conflict between the women and men in the village. While the men found that dragonflies are good natural enemies, the women are removing them just as fast in the larval stage. Pak Oyo organised a field school especially for women in the villages to educate them about natural enemies, including dragonflies. This would help women in the village to value the dragonfly nymphs.

Pak Oyo and his friends also reported that some conditions affect the well being of dragonflies in the rice field. The use of insecticides such as carbofuran will kill off the kini-kini and this will reduce the number of dragonflies. In addition, they found that when rice fields are drained, for example to manage rats, the population of kini-kini will decline too. Both observations were confirmed in studies conducted by farmers in Boyolali and Indramayu.

It has been suggested by some biological control specialists that dragonflies may not be all that important in controlling BPH. This is probably true, as BPH concentrates near the base of rice plants. However, dragonflies will probably remove the arriving and departing macropterous adults. However, a better way of looking at this issue is to consider that encouraging dragonflies is to encourage a whole community of predators. When farmers put out markers for dragonflies instead of spraying insecticides, this means that important predators of BPH, such as the Wolf Spider, *Lycosa pseudoannulata*, are conserved. Hence, the approach to help farmers better understand biodiversity and promote conservation would encourage more innovative ways of appreciating biological control.

Discussion and Conclusions

These three case studies have been selected from more than 100 similar studies conducted by Indonesian farmers who have graduated from FFSs. They were selected to demonstrate the range of studies, facilitation and understanding necessary to sustain IPM by farmers.

A most important lesson from these examples is that given the opportunity to be innovative, rice farmers have the creativity to be able to solve pest problems. A similar development was reported by Bentley et al. (1994) in Honduras. Farmers have used their inherent discovery abilities and science to come out with a fresh way of appreciating the rice ecosystem, including the ecology of pests and natural enemies. This science at grass root level starts with the ability to ask "Why?" and to seek the answers themselves in consultation with friends and resource persons.

The role of resource persons in developing science with farmers is discussed by Settle (1997) and points to the need for a new approach by scientists for working with farmers as partners in science. Moreover, it also requires that scientists/researchers and other agricultural professionals have to review their standing (Matteson, 1996) and adopt 'new systems of learning' based on true participation (Pretty, 1995). A most important role for IPM is not just to provide a better way of pest management, it is providing an opportunity to farmers to want to do science and to learn by experimenting. It is not surprising, therefore, that IPM is an entry point to sustainable agriculture (Schmidt et al., 1997)

A common question is how do we assess the success of IPM? The criteria for evaluation should be based on behavioural changes in farmers: how they approach problems in their fields, regardless of whether these are insects, diseases, weeds, water, fertiliser, or varieties or soils. The purpose of Community IPM is to help farmers become able to organise themselves, to become experts and effective

trainers of other farmers and capable of field research (Bartlett, 1998). Questions framed along these lines would then be able to judge if indeed farmers have benefited from an IPM programme where they desire to improve themselves through increased income, to have self confidence and to become effective citizens, contributing to the well-being of the community and the country.

A parochial view of IPM as a purveyor of poisons, of centrally controlled instructions to farmers, of developing simple condescending messages for farmers and formulation of naive and often impractical agricultural packages, is nothing less than an attempt to continue the exploitation of farmers by a very small part of the population, risking food security and destroying the fabrics of society through degradation of the environment and increasing health hazards.

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