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Farmer Field Schools on Chili Peppers in Aceh, Indonesia: Activities and Impacts

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An evaluation of a farmer field school (FFS) program for chili peppers was conducted to measure impacts on farmers' knowledge of chili pepper integrated crop management (ICM) in Aceh Province, Indonesia. Chili production was selected as the target intervention topic because of its importance in Aceh's economy. Quantitative and qualitative methods were used to assess impacts of FFS; 270 FFS-graduate farmers were interviewed and eight farmer groups were surveyed. By integrating descriptive and simple statistical analyses, we measure immediate impacts of FFS, which also makes this study's methods and findings different from others in the literature. The results show that farmers' knowledge on agricultural practices increased significantly due to FFS. In addition, in the future, farmers expected that their chili yields would increase and their pesticide use would decrease. FFS improved farmer cohesiveness and information sharing. Farmers' knowledge of insect pests, diseases and natural enemies increased considerably, as did their awareness of pesticide-related hazards. In sum, FFS successfully

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delivered improved technology and enhanced knowledge to enable farmers to grow chili with sustainable practices and higher profits.

KEYWORDS integrated pest management, chili peppers, farmers' knowledge, farmer field school

INTRODUCTION

An evaluation of farmer field schools (FFS) was conducted to measure impacts from this intervention to help disaster-affected farmers to recover from the 2004 tsunami in Aceh, Indonesia. Key features of these chili pepper FFS implemented in 2008–2009 are briefly described, followed by immediate impacts of the FFS on Aceh farmers' knowledgebase for growing chili peppers and other vegetables.

The tsunami of December 2004 damaged nearly 40,000 ha of agricultural land in Aceh province, affecting up to 92,000 farms and small enterprises. Over 600,000 men and women lost their livelihoods due to this disaster (Food and Agriculture Organization of the United Nations 2005). In response, AVRDC–The World Vegetable Center led a research and development project in Aceh in 2006–2010 to restore soil fertility, enhance food security, and improve nutrition and livelihoods in tsunami-affected communities through rehabilitation of vegetable production and building technical capacity of farmers and national staff on integrated crop management. The project was funded by the Australian Centre for International Agricultural Research (ACIAR). One major component of the project was implemented through adapted FFS on vegetables in 77 villages. Vegetable production creates more income and jobs per hectare than cereal production (Weinberger and Lumpkin 2005), hence, vegetable FFS were initiated to quickly restore and improve rural livelihoods. Chili pepper was selected as the main crop for FFS in Aceh, due to high interest among farmers to plant it, as found in a participatory assessment in 2007. Many farmers requested FFS on chili during the rapid survey and consultation with farming communities in 2008, due to good market price of chili and higher profit margin than from other crops. Chili peppers have the highest vegetable crop acreage in Aceh, covering 9680 ha in 2007 (Badan Pusat Statistik 2008).

FFS is a process of learning by doing (Dilts and Hate 1996). After facing difficulties with adoption and diffusion of integrated pest management (IPM) practices across farming communities in Indonesia, and severe insect pest outbreaks on rice leading to food scarcity, the World Bank along with a number of development agencies promoted FFS in the country. It was believed then that FFS was a more effective method to extend science-based knowledge and practices than alternatives such as training and visit (Feder et al. 2004). FFS uses a participatory approach to assist farmers to develop their capabilities in analytical skills, critical thinking, and creativity so that farmers can make better decisions (Luther et al. 2005). In short, the objective of FFS is to enhance human resource development, in which farmers become experts in their fields. Farmers are expected to be able to conduct observations, analyze agroecosystems, make decisions, and implement pest control strategies based on the results of their field observations. In this process, the FFS involves pest control and other aspects of integrated crop management such as balanced and efficient fertilization, efficient water use, crop rotation, and soil conservation.

In Aceh, the process of FFS was carried out using an agroecosystem analysis framework. Participants learnt about the agroecosystem and dynamics of insect populations during the process of making observations in two plots during one planting season. They were planned as per structure of local agroecological systems. The key to understanding pest outbreaks lies in comprehending the dynamics of relationships between pests and their natural enemies, and many farmers lack knowledge of these relationships. FFS lessons are designed to elucidate the complexities of agroecosystems. Farmers observe the dynamics of insects within natural food chains in agroecosystems. One of the most important concepts discovered by farmers in FFS is the ability to determine whether an insect is a pest, which is damaging, or a natural enemy, which is beneficial, to crop production. This is extremely important for being able to effectively implement IPM.

FFS, which were originally created for IPM training, have been adapted for many areas of agriculture, forestry and health (Gallagher 2003). FFS utilize a participatory learning process, which lasts the entire length of the season for annual crops and a variable length of time for perennial crops. In many of the farming sector training activities in Indonesia, a FFS approach has been adapted locally (Luther et al. 2005; Pontius et al. 2002), and relevant adaptations were also made in Aceh under the project described in this article. In this project, FFS were adapted to emphasize soil remediation techniques due to tsunami effects, but other integrated crop management (ICM) technologies were also included, such as IPM. In this context, the objective of this study is to evaluate impacts of an ICM-based FFS process for chili pepper, using key indicators of farm performance.

LITERATURE REVIEW

In Indonesia, FFS has been a popular method to disseminate new agricultural technologies for over 20 years, and it is practiced with various annual and perennial crops. Many FFS in Indonesia have focused on IPM. FFS evolved and became popular after the Government of Indonesia revolutionized its policy on plant protection by implementing the national IPM program initiated in 1986 under Presidential Decree No. 3. The program was motivated by the fact that pesticides were not wisely used. The unwise use of pesticides led to economic losses associated with pest outbreaks in the 1960s (Settle et al. 1996) and in the 1980s (Barbier 1989). In addition, there were other adverse impacts of unwise use of pesticides such as environmental and health problems (Kishi et al. 1995; Bond 1996). The program was then conducted in 1989 (Rölling and van de Fliert 1994), with the objectives of IPM training being: higher productivity, increased farmers' income, monitored pest populations (i.e., to keep pests below economic threshold levels), limited use of chemical pesticides, and an improved environment and better public health (Untung 1996).

There exists a strong claim that the Indonesian IPM program has been able to reduce the use of pesticides significantly. In the field trials, the training has been able to cut down pesticide use by 50% without sacrificing the level of production (Bond 1996). Farmers have adopted the IPM principles (Kuswara 1998a, 1998b; Paiman 1998a; 1998b; Susianto et al. 1998) and there is an indication of strong diffusion of IPM knowledge among farmers (Mariyono and Kuntariningsih 2007). By using a participatory approach, Mancini and Jiggins (2008) show, "that the deeper understanding of the occupational hazard of handling pesticides indeed induced a change in the FFS participants' attitudes towards pesticides" (548). Underpinning the rise of participatory research has been a realization that the poor in general, and poor marginal farmers in particular, are far from being a homogeneous group. Thus, technologies have to be selected and adapted for particular systems. Based on an empirical study of successful adaptation and spread of pro-poor technologies, it has been found that farmers who are members of FFS groups are significantly better off than non-member farmers (Lilja and Dixon 2008).

In other countries, FFS methods have been adopted to introduce new concepts and technologies. A summary of Lilja and Dixon (2008) reveals that participatory research involving an impact assessment of agricultural technology, farmer empowerment, and changes in opportunity structures in several countries argues that rural poverty has been reduced by combining farmer-empowerment and innovation through experiential learning in FFS groups, and changes in the opportunity structure through transformation of local government staff, establishment of new farmer-governed local institutions, and emergence of private service providers.

In summary, FFS is an effective method to disseminate improved technologies to farmers. Many studies have shown this approach to be effective. Modified and adapted FFSs on other crops and topics are expected to have positive impacts on farming practices and improve understanding of farmers on such topics.

METHODS

Concept

It is expected that FFS would provide positive impacts and increase the farmers' knowledgebase on cultivation of a particular crop after they attend the season-long FFS. This study used ex-ante impact evaluation methods. However, farmers who were interviewed had already completed FFS training and the associated cropping experiences for one cropping season, and, thus, they could apply the knowledge and technology learnt during the FFS in the next cropping season. Then farmers were asked to provide their expectations and perceived effects of FFS on a range of vegetable farming issues based on what they learned during hands-on training in the FFS. Considering the short time span of evaluation, this study adopted the before-and-after approach of assessment, and what information (indicators or variables) that farmers could recall as variable indicators were closely influenced by the FFS interventions in the village.

Based on the information that participatory and conventional methods are complementary, this study used individual and participatory group surveys. Participatory methods were used to enhance the effectiveness of research and technology development in the agricultural sector has found increasing support from institutions and donors since the 1980s (Mancini and Jiggins 2008). Participatory methods are necessary to enable researchers, extensionists, institutions, and donors to ask the right questions. However, the methods are not sufficient for of several reasons, and the hypotheses and generalizations in the report about farmer problems and constraints remain statistically untested, mainly because most of the data gathered remain qualitative in nature (Gladwin and Peterson 2002). These data, however, are very important in terms of understanding farmers' constraints and opportunities when adopting new technologies.

Analysis

Impact assessments of extension and dissemination programs require appropriate analysis techniques because the targets of these programs are not randomly selected, rather, non-probabilistic sampling is used (Feder et al. 2004). In agricultural extension projects the participants and locations are usually selected with several criteria. For example, active and innovative farmers at easily accessible locations are the common criteria for participant selection. Active and innovative farmers are selected because they are expected to adopt new technologies and ideas more readily than other farmers and then become a source of information for neighboring farmers. Locations that are easily accessed, which are close to main roads, markets and city centers, usually have better land fertility. Many agricultural projects have similar targets, and thus it is likely that farmers who meet such criteria

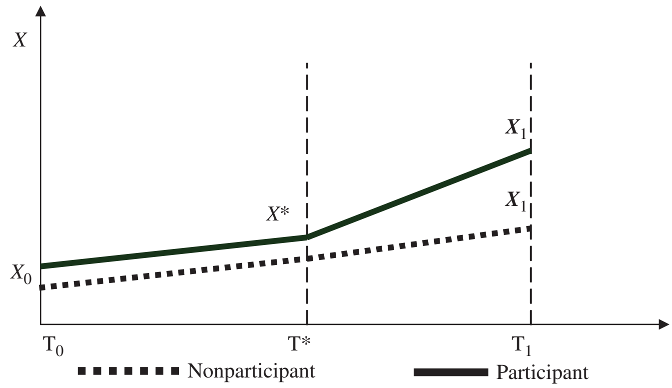

FIGURE 1 Evolution of learning process.

have participated in more than one project or program. Such conditions lead to what is called "selection bias," if we conduct an impact assessment by directly comparing measures of farmers with and without project involvement (Feder et al. 2004). As a result, farmers selected for a program very likely already have better conditions than others, regardless of the program.

In practice, FFS programs normally do not select locations and participants randomly, and, thus, this also leads to selection bias. To deal with such conditions, we combine the techniques "with and without FFS" and "before and after FFS" by measuring the difference between participants and nonparticipants, before and after FFS. In this case, we measure the growth rate of change. Figure 1 illustrates the measurement using the combination of such techniques.

In Figure 1, the solid and dotted lines represent participating and nonparticipating farmers in FFS, respectively. T_0, T^*, and T_1 are initial time, time of FFS, and time of assessment, correspondingly. Thus, $(T^* - T_0)$ is the time period during program, and $(T_1 - T^*)$ represents the time period after program. Before FFS, both participants and nonparticipants grow together at the same rate. But after the program, the participants grow faster than nonparticipants because of the impact of FFS.

In mathematical terms, it can be formulated as

$$X_1 = X_0 e^{\alpha(T^* - T_0) + \beta N(T_1 - T^*) + \delta P(T_1 - T^*)}, \quad (1)$$

where X is variable measure; N is nonparticipant; P is the participant; α, β, δ; are growth rate before FFS, the growth rate of nonparticipants and participants, respectively, and e denotes exponential operator. The impact of FFS on performance of participants can be measured by $(\delta - \beta)$. Since we expect that $\alpha < \beta < \delta$, then the impact should be positive. If $(T_1 - T^*)$ is quite long, there is a chance for nonparticipants to learn from participants through a process of diffusion. In this assessment, this is not the case, because the impact of FFS is immediately assessed after completion of FFS. Thus, $\beta = 0$ and $\delta > 0$, and Equation (1) will become:

$$X_1 = X_0 e^{\alpha(T^* - T_0) + \delta P(T_1 - T^*)} \tag{2}$$

Taking logarithmic operation of both left and right sides of Equation (2) gives:

$$\ln \frac{X_1}{X_0} = \alpha(T^* - T_0) + \delta(T_1 - T^*) \tag{3}$$

The right-hand side of Equation (3) is positive, meaning that $X_1 > X_0$. In other words, there is an improvement on the performances of farmers after participating in FFS.

Data Collection and Survey Sampling

In a participatory group survey, 6 FFS groups consisting of 10–12 farmers who had graduated from FFS were surveyed. Implications of the FFS on farmers' knowledge and understanding on crop management practices were assessed. Pre- and post-knowledge levels of farmers, for a sample of 8 FFS sites comprised of 200 FFS-participating farmers, were compared. Before participating in FFS, farmers were assumed to have a score of $X_0 = 10$ on each factor. Immediately after completing the FFS sessions, farmers were asked to record improvement by adding the existing score. The changes were then measured as a percentage formulated as:

$$\%C = \frac{X_1 - 10}{10} \otimes 100\%, \tag{4}$$

where X_1 is the score reported by farmers after completing FFS, and $\%C =$ change in value of score in percentage terms. A simple t test at 95% confidence interval (Spiegel 1972) was adopted to test the significance of change after FFS participation.

An individual survey on FFS impact assessment was conducted using a structured form; 270 farmers were interviewed in 27 FFS sites. Data were collected by one-on-one consultation with farmers. In this case, farmers were asked about farming expectations or predictions due to technologies introduced during FFS.

For general information, mean value of a particular variable was calculated using sample average of the variable, which is formulated as:

$$\bar{X} = \frac{\sum_{i=1}^{N} X_i}{N}, \tag{5}$$

where X is the variable of i^{th} to be analyzed, N is the number of samples.

The knowledge on crop protection aspects were analyzed using weighted rank (WR), which is formulated as:

$$WR = \frac{\sum n. * S}{N}, \tag{6}$$

where n is number of farmers responding to each category, S is score, and N is total sample. A higher score was given for a particular response (variable) when farmers reported that such a variable was more important. For example, during the field survey, if there were five choices, and a farmer gave a first rank for a certain variable in a list, then the particular variable was scored as 1. If the farmer put it in the second rank, then it was scored 2, and so on. If the farmer did not mention anything, then the score for this particular factor was zero. Thus, a higher value of weighted average rank means the factor (response) is more important and mentioned by many farmers during the survey. For consistency in data analysis and ease in reporting the results, the ranks are inverted: the first rank is converted to 5 and lowest rank is converted to 1. Therefore, the higher the score for a factor, the higher the importance of the particular factor among the range of other choices/factors listed by the farmers.

In some cases, the results are analyzed by geographical areas to determine if geographical differences exist. Three areas are analyzed: 1) Aceh Besar, consisting of Aceh Besar District; 2) Pidie, consisting of Pidie and Pidie Jaya Districts; and 3) Northeast Aceh, consisting of Bireuen and Aceh Utara Districts.

RESULTS AND DISCUSSION

Group Survey

Findings from the group survey, related to aspects of chili farming after participating in FFS, are provided in Table 1. Farmers reported that their knowledge and skill on many aspects of chili farming improved substantially as a result of FFS participation. Using the impact scoring method, we have analyzed the changes in the farming knowledgebase of the participants. After attending the FFS, the participants' knowledge on plant protection showed an increase of around 40 per cent relative to their level of understanding before the FFS.

Farmers' understanding of insect pests, diseases, natural enemies, and pesticides has increased dramatically. Before participating in the FFS, farmers knew little about pests and diseases on chili and kinds of pesticides to apply for a particular pest/disease. Before the FFS, farmers knew almost nothing about natural enemies; they thought that all insects in the field were pests.

TABLE 1 Improvement in farmers' knowledge on integrated crop management aspects of chili farming

	Percentage change after completing the FFS							
	Aceh Besar		Pidie		Northeast Aceh		Overall	
Topics/Issues	Mean	t test	Mean	t test	Mean	t test	Mean	t test
Insect pests	40	3.08	34	3.09	41	5.13	38	3.17
Diseases	42	3.50	40	4.44	46	4.60	42	4.20
Natural enemies of pests	40	3.33	36	4.00	38	5.43	38	3.80
Pesticides	42	5.25	43	5.38	50	3.13	44	4.40
Soil fertility	37	4.11	38	2.71	42	3.82	39	3.55
Use of organic fertilizers	50	2.78	40	2.22	49	3.50	46	2.71
Use of fertilizers	43	4.78	45	9.00	38	2.92	43	4.78

Note: t test indicates that the mean value is statistically greater than zero, tested at 95% confidence interval. A t test value greater than 1.96 indicates significant positive change. All results in Table 1 are, therefore, statistically significant.

TABLE 2 Improvement in farmer cohesiveness and information sharing

	Percentage change after the FFS							
	Aceh Besar		Pidie		Northeast Aceh		Overall	
Particulars	Mean	t test	Mean	t test	Mean	t test	Mean	t test
Cohesiveness of farmers in the community	34	1.89	43	2.87	51	3.19	41	2.28
Information sharing within farmers' groups	49	4.08	43	5.38	53	4.82	48	4.36
Information sharing between farmers' groups	47	3.92	43	5.38	43	3.58	45	4.09

Note: t test indicates that the mean value is statistically greater than zero, tested at 95% confidence interval. A t test value greater than 1.96 indicates significant positive change.

After attending FFS, farmers now realize that not all insects are pests and they can distinguish between harmful and beneficial insect species or groups. Likewise, they are also able to distinguish between pollinators and natural enemies of pests. Farmers' knowledge on pesticides has been enhanced substantially, particularly knowledge on botanical pesticides. After the FFS, farmers also know that pesticides do not only kill insect pests, but also eliminate beneficial insects from the field, such as natural enemies of pests and insect pollinators.

After completing the FFS, farmers felt that their knowledge on managing soil fertility and fertilizer application was enhanced by 39–46%, compared to what they knew earlier (Table 1). After attending the FFS, the solidarity of farmers' groups was also enhanced (Table 2); cohesiveness of farmers in the community improved 41%. Likewise, after completing the FFS, intensity of

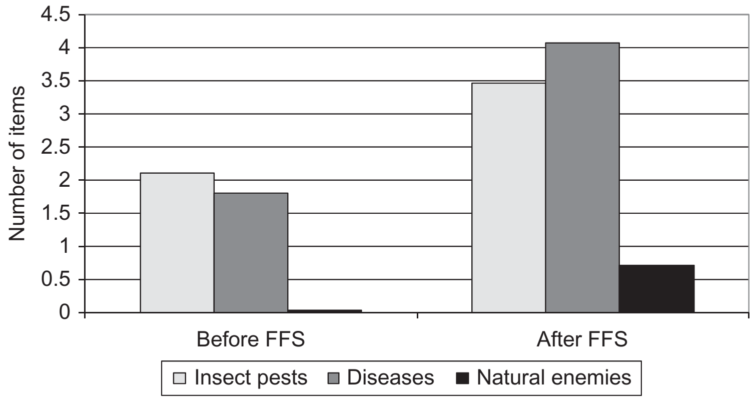

FIGURE 2 Change in knowledge of insect pests, diseases and natural enemies.

information sharing within farmers' groups rose 48% and between farmers' groups rose 45%.

Individual Survey

Overall, farmers' knowledge on chili ICM improved due to FFS participation. On average, farmers stated that their overall knowledge on chili farming was enhanced by 70%.

Specifically, farmers' knowledge of insect pests, diseases, and natural enemies increased considerably (Figure 2). Farmers' knowledge of insect pests almost doubled and knowledge of diseases more than doubled due to FFS participation. Many farmers did not know any natural enemies before participating in the FFS, but afterward, one out of every two farmers could name at least one natural enemy of insect pests (Figure 2).

In addition to the number of pests, diseases, and natural enemies known, there were substantial changes in the perceptions of such issues. Table 3 shows the five most important pests, diseases and natural enemies on chili, as perceived by farmers before and after participating in the FFS. They also could distinguish between the concepts of pests and diseases. Perceptions about insect pests and natural enemies also changed substantially during the FFS. However, disease identification was difficult for farmers since the signs and symptoms of different diseases are similar. As shown in Table 3, before participating in FFS, farmers perceived some unimportant insect pests to be serious pests (such as grasshoppers); this type of perception can lead to pesticide abuse, since farmers are likely to spray heavily for pests that do not require control measures, in cases like these.

The before-and-after differences imply that farmers did not understand the roles of every pest, disease and natural enemy before the FFS, and that learning occurred during the FFS. Farmers' perceptions of insect pests

TABLE 3 Change in farmers' perceptions of the importance of pests, diseases and natural enemies on chili pepper

	Before FFS			After FFS		
Rank	Pests	Diseases	Natural enemies	Pests	Diseases	Natural enemies
1	Bugs	Curling leaves	Birds	Whiteflies	Curling leaves	Wasps and bees
2	Caterpillars	Decayed fruit	Dragonflies	Bugs	Fruit spoiled	Dragonflies
3	Fruit flies	Anthracnose	Ants	Caterpillars	Anthracnose	Spiders
4	Grasshoppers	Rotten root	Grasshoppers	Fruit flies	Spotted leaves	Coccinellid beetles
5	Curling leaves	Bacterial wilt	Spiders	Aphids	Gemini viruses	Grasshoppers

Note: Rank 1 stands for the most important pest/disease/n.e. and rank 5 stands for least important.

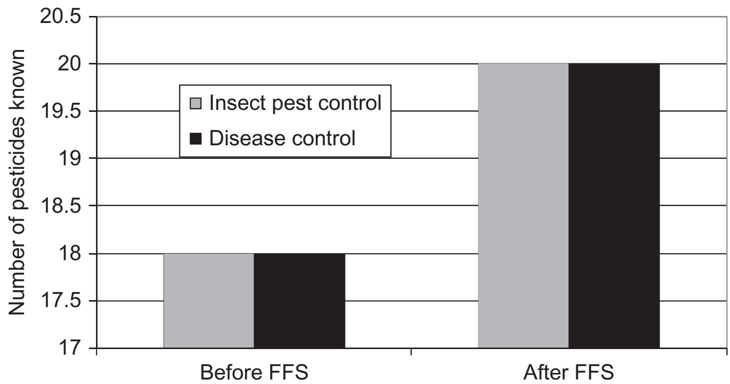

FIGURE 3 Change in pesticide knowledge.

changed substantially. For example, before FFS, farmers did not differentiate whiteflies from other "bugs," but afterward, whiteflies were ranked as the most important pest. Similarly, their perception of the importance of natural enemies changed due to FFS. Previously, farmers believed that birds were the most important natural enemies in their farm. However, after FFS, they believed that wasps and bees are the most important natural enemies of chili pests, while birds dropped off of the top five on the list.

Even though farmers could already recognize many pesticides before participating in FFS, knowledge on pesticide use also increased (Figure 3). Before participating in FFS, farmers knew over 17 kinds of pesticides used for insect pests and 17 for diseases. After participating in FFS, farmers recognized around 20 kinds of pesticides used for controlling insect pests and 20 for diseases.

Knowledge of adverse impacts of pesticides was also enhanced. Table 4 shows that before participating in FFS, over 80% of surveyed farmers were aware that pesticides can adversely affect human health, but very few were aware of several other common hazards from pesticides. After completing

TABLE 4 Hazards from pesticides reported by farmers

	Percentage of farmers							
	Before FFS				After FFS			
Description	Aceh Besar	Pidie	NE Aceh	Total	Aceh Besar	Pidie	NE Aceh	Total
Human health	80	84	83	82	100	100	100	100
Killing natural enemies	7	2	3	4	100	100	100	100
Poisoned wildlife	1	0	25	8	100	100	100	100
Soil contamination	1	5	0	2	100	100	100	100
Polluting environment	1	0	6	2	100	100	100	100
Pest and disease resistance	0	0	3	1	100	100	100	100

TABLE 5 Impacts of FFS on predicted crop yield and pesticide use

	Number of farmers reporting							
	Aceh Besar		Pidie		Northeast Aceh		Overall	
Description	n	%	n	%	n	%	n	%
Increased yield of chili								
no improvement	0	0	4	4	0	0	4	1
10%	24	20	9	10	7	12	40	15
25%	61	51	57	63	42	70	160	59
50%	31	26	15	17	10	17	56	21
60% or more	4	3	2	2	1	2	7	3
Decreased pesticide use								
no change	0	0	0	0	0	0	0	0
10% less	19	16	7	8	5	8	31	11
25% less	54	45	37	41	19	32	110	41
40% less	32	27	26	29	16	27	74	27
50% less	15	13	18	20	18	30	51	19

Note: n = number of farmers who responded affirmatively under each category.

the FFS, all farmer participants were aware that pesticides can adversely affect human health, kill natural enemies and other beneficial organisms, contaminate soil and the environment in general, as well as cause pest and disease resistance (Table 4).

Importantly, with the enhanced knowledge, farmers were confident that in the following season, they would be able to increase chili productivity with reduced chemical pesticide use. Table 5 shows that only 1% of farmers predicted no increase in yield; none of them predicted no change in pesticide use.

Almost 60% of the farmer participants surveyed expected that they would be able to increase chili yields by 25% and over 40% of the farmers reported they would be able to reduce pesticide use by 25% in the following season. In fact, over 20% of farmers predicted that they would be able to increase crop yield by around 50% and 19% of farmers reported that they would be able to reduce pesticide use by 50%. These results indicate a high performance level of the FFS, which are designed to enable higher crop productivity and lower pesticide use (Mariyono 2009).

CONCLUSIONS AND IMPLICATIONS

During 2008–2009, a chili pepper based farmer field school program on ICM, focusing on soil and pest management, was implemented in selected communities in Aceh that were affected by the 2004 tsunami. Results from the evaluation of this FFS program show that the FFS enhanced farmers' knowledge and skill on crop production, and empowered the farmer groups. These FFS have created positive impacts on farmers' knowledge and farming practices in several respects. The farmers' increased knowledge about insect pests, diseases, and natural enemies will help them to more effectively implement IPM. This in turn should help bring about the expected reduction in pesticide use and increase in chili pepper yield. FFS have successfully introduced many technologies to farmers, as indicated by the fact that farmers stated that they will utilize and adopt many of the technologies in the FFS curriculum.

In short, FFS has successfully delivered improved knowledge on chili production to farmers across five districts of Aceh. This knowledge is also relevant for producing other vegetables and for farming practices in general. Farmers expressed interest in continuing FFS in the future, even if it means sharing part of the implementation costs, which shows that they value the FFS as being useful and worthwhile. Overall, this vegetable FFS program created a wide range of positive impacts for resource-poor farmers in Aceh.

REFERENCES

Barbier, E. B. 1989. Cash crops, food crops and sustainability: The case of Indonesia. *World Development* 17(6): 879–875.

Bond, J. W. 1996. *How EC and World Bank policies are destroying agriculture and the environment*. Singapore: Agbé Publishing.

Badan Pusat Statistik. 2008. *Statistik Indonesia*. Jakarta: Badan Pusat Statistik.

Dilts, D., and S. Hate. 1996. IPM farmer field schools: changing paradigms and scaling up. *Agricultural Research and Extension Network Paper* 59(B):1–4.

Feder, G., R. Murgai, and J. B. Quizon. 2004. Sending farmers back to schools: the impact of farmer field school in Indonesia. *Review of Agricultural Economics* 26(1): 45–62.

Food and Agriculture Organization of the United Nations. 2005. *Needs assessment: Indonesia post-tsunami consolidated assessment*. http://www.fao.org/ag/tsunami/assessment/indonesia-assess.html (accessed April 22, 2005).

Gallagher, K. 2003. *Farmer field schools: From IPM to platforms for learning and empowerment. Users' perspectives with agricultural research and development*. Los Banos, Laguna, Philippines, CIP-UPWARD.

Gladwin, C. H., and J. S. Peterson. 2002. The quality of science in participatory research: a case study from eastern Zambia. *World Development* 30(4): 523–543.

Kishi, M., H. Norbert, M. Djayadisastra, N. L. Satterlee, S. Strowman, and R. Dilts. 1995. Relationship of pesticides spraying to signs and symptoms in Indonesian farmers. *Scandinavian Journal of Work, Environment & Health* 21(2): 124–133.

Kuswara, E. 1998a. IPM in Marga Sub-District, Tabanan District, Bali. In *Community IPM: Six cases from Indonesia*, 100–137. Jakarta, Indonesia: Semiannual FAO IPM Technical Assistance Progress Report.

Kuswara, E. 1998b. IPM in Tulang Bawang Udik Sub-District, Lampung. In: *Community IPM: Six cases from Indonesia*, 221–248. Jakarta, Indonesia: Semiannual FAO IPM Technical Assistance Progress Report.

Lilja, N., and J. Dixon. 2008. Operationalising participatory research and gender analysis: new research and assessment approaches. *Development in Practice* 18(4–5):467–478.

Luther, G. C., C. Harris, S. Sherwood, K. Gallagher, J. Mangan, and K. T. Gamby. 2005. Developments and innovations in farmer field schools and the training of trainers. In *Globalizing integrated pest management—A participatory research process*, eds. G. W. Norton, E. A. Heinrichs, G. C. Luther, and M. E. Irwin, chap. 9, Ames, IA: Blackwell.

Mancini, F., and J. Jiggins. 2008. Appraisal of methods to evaluate farmer field schools. *Development in Practice* 18(4): 539–550

Mariyono, J. 2009. Integrated pest management training in Indonesia: does the performance level of farming training matter? *Journal of Rural and Community Development* 4(2): 93–104.

Mariyono, J., and A. Kuntariningsih. 2007. Keunggulan ekonomi, penerapan teknologi PHT, dan sosial ekonomi usahatani padi beririgasi teknsi di Kecamatan Moyudan, Yogyakarta. *Journal Studi Ekonomi* 2(2): 155–168.

Paiman, P. 1998a. An IPM case study in Gerung Sub-District, West Lombok District, West Nusa Tenggara. In *Community IPM: Six cases from Indonesia*, 138–166, Jakarta, Indonesia: Semi-annual FAO IPM Technical Assistance Progress Report.

Paiman, P. 1998b. An IPM case study in Ngantang Sub-District, Malang District, East Java. In *Community IPM: Six cases from Indonesia*, 168–189. Jakarta, Indonesia: Semi-annual FAO IPM Technical Assistance Progress Report.

Pontius, J., R. Dilts, and A. Bartlett. 2002. *Ten years of IPM training in Asia–from farmer field school to community IPM*. Bangkok: FAO Community IPM Programme, FAO Regional Office for Asia and the Pacific.

Rölling, N., and E. van de Fliert. 1994. Transforming extension for sustainable agriculture: The case of integrated pest management in rice in Indonesia. *Agricultural and Human Value* 11(2–3):96–108.

Settle, W. H., H. Ariawan, E. T. Astuti, W. Cahyana, A. L. Hakim, D. Hindayana, A. Lestari, S. Pajarningsih, and ?. Sartanto 1996. Managing tropical rice pests through conservation of generalist natural enemies and alternative prey. *Ecology* 77(7): 1975–1988.

Spiegel, M. R. 1972. *Statistics*, Schaum's Outline Series. New York: McGraw Hill.

Susianto, S., D. Purwadi, and J. Pontius. 1998. Kaligondang Sub-District: A case history of IPM Sub-district. In *Community IPM: Six cases from Indonesia*, 15–99. Jakarta, Indonesia: Semi-annual FAO IPM Technical Assistance Progress Report.

Untung, K. 1996. Institutional constraints on IPM implementation in Indonesia. *Publication of the Pesticide Policy Project, Publication Series* 3(A):37–47.

Weinberger, K., and T. A. Lumpkin. 2005. Horticulture for poverty alleviation: The unfunded revolution. Working Paper No. 15. AVRDC–The World Vegetable Center, Shanhua, Tainan, Taiwan.