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Research Article

The Knowledge and Attitude of Integrated Pest Management Farmers Field Schools Alumni toward the Use of Pesticides in Klaten, Central Java, Indonesia

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ABSTRACT

The field schools in Indonesia employ an extension alternative model that is considered appropriate to change the habits and behavior of farmers to make them IPM experts in their field. This study was conducted to understand the behavior (knowledge and attitude) of farmers who have joined field schools, i.e. Integrated Pest Management Farmers Field School (IPM-FFS) and Landscape Integrated Pest Management (Landscape IPM), toward the use of pesticides in Klaten, Central Java, Indonesia. The research used a survey method with purposively selected respondents comprising 55 farmers of the IPM alumni and 25 farmers of the Landscape IPM alumni. A descriptive analysis was conducted to analyze the farmers' knowledge and attitude toward the use of pesticides. Mann-Whitney U-test analysis was performed using Statistical Product and Service Solution (SPSS) version 23, to compare the knowledge and attitude of farmers regarding the use of pesticides. The results showed that the knowledge of farmers of the Landscape IPM alumni regarding the use of pesticides was higher than that of farmers of the IPM-FFS alumni. There was no difference in the behavior of farmers between the IPM-FFS alumni and the Landscape IPM alumni regarding their attitude toward the use of pesticides.

Keywords: farmers' attitude, farmers' behavior, farmers' knowledge, field schools, pesticides

INTRODUCTION

Farmer education through field schools is a fairly effective approach that can be used to deliver knowledge to be applied by farmers (Feder *et al*., 2004). The aim of a field school model is to help farmers learn about the ecology and integrated crop management to make them more confident in making decisions to manage their farms (Iqbal *et al*., 2012).

The Food and Agriculture Organization (FAO) had pioneered the dissemination of integrated pest management (IPM) systems in Southeast Asia through field schools as a means to introduce participatory-based pest management to farmers (Yorobe *et al*., 2011). The evaluation results of the implementation of Integrated Pest Management Farmer Field Schools (IPM-FFS) in several other countries have indicated the increase in agricultural production and profits and the decrease in the use of chemical pesticides (FAO, 2000 *cit* Feder *et al*., 2004). The successful implementation of IPM can be seen from the reduce use of chemical pesticides (Hariadi, 2006).

Integrated Pest Management Farmer Field Schools (IPM-FFS) are schools held in the field, similar to other general schools, and they also have a curriculum (The Directorate of Food Crop Protection, 2010). The learning pattern in IPM-FFS employs the adult education pattern or participatory training. Farmers are invited and encouraged to learn together and make ecosystem management decisions including the collective control of pests (Untung, 2007). Expected results from IPM-FFS include knowledge enhancement and the ability of decision-making by the farmers. This is expected to reduce the use of pesticides, increase production, and ultimately increase the economic benefits (David & Asamoah, 2011).

Currently, the new paradigm of attention of researchers, decision-makers, farmers, and other stakeholders and one that has also been applied in other countries is the Area-Wide Pest Management (AWPM). In general, the concept of AWPM includes pest management using one primary technology or a combination of several existing technologies for one major pest in a large area (Faust, 2008). One of

the principles of the implementation of IPM is that farmers serve as managers in their own land, which consequently results in different practices between neighboring farmers or between neighboring IPM farmer groups. Hence, a combination of IPM and AWPM, i.e., the Landscape IPM has been developed to anticipate the implementation of the joint program in pest management. The FAO along with the Ministry of Agriculture of the Republic of Indonesia implemented a Landscape IPM Pilot Project in 2014−2015 in six regencies in Indonesia (Trisyono, 2015), one of which was in Klaten regency.

The field schools in Indonesia employ an extension alternative model that is considered appropriate to change the habits and behavior of farmers to make them IPM experts in their field. The Integrated Pest Management Farmer Field School (IPM-FFS) is one of the programs supporting the implementation of IPM in Indonesia, which is then followed by the Landscape-Integrated Pest Management (IPM) program, a combination of IPM and Area-Wide Pest Management.

The implementation of Landscape IPM is an innovation of the IPM-FFS program that has been implemented in Indonesia. Table 1 shows some of the differences between IPM-FFS and Landscape IPM.

According to Bloom in Sudargo *et al*. (1998), behavior is a pattern of action that consists of cognition measured from knowledge, affection measured through attitude or responses, and psychomotor activity measured through the actions performed. The behavior observed in this study is farmers' knowledge and attitude toward the use of pesticides. Attitude is a positive or a negative assessment of a psychological object. The attitude of a person toward an object is a supportive or a non- supportive feeling about the object (Azwar, 1995). In the present study, attitude can be interpreted as a response of interest to accept or reject the IPM principles based on the assessment of the principles (Karlina, 2013).

The purposes of this study are to compare between two farmers field school models (Integrated Pest Management Farmers Field School and Landscape Integrated Pest Management), based on the knowledge and attitude of farmers who have participated in the field schools. The specific objectives are to understand the behavior (knowledge and attitude) of farmers who have joined farmers field schools, i.e., Integrated Pest Management Farmers Field School (IPM-FFS) and Landscape Integrated Pest Management (Landscape IPM), toward the use of pesticides in Klaten, Central Java, Indonesia.

MATERIALS AND METHODS

This research was conducted in the form of a survey among farmers who have participated in a field school in Klaten. These farmers had participated in the IPM-FFS from 2009 to 2013 and in the Landscape IPM implemented in 2014. This study included a total 80 farmers grouped as 55 farmers of the IPM alumni and 25 farmers of the Landscape IPM alumni. Landscape IPM activity in Klaten has been implemented in 1 unit with 25 participants. All Landscape IPM participants were respondents in this study. Data were collected using questionnaires and interviews using purposive sampling method (Singarimbun & Effendi, 1996). The research site was the rice cultivation center in Klaten regency covering four districts (Trucuk, Karanganom, Gantiwarno, and Juwiring). The survey was conducted during May to June 2016.

The validity and reliability of the question and statement items have been previously tested. Descriptive analysis and Mann-Whitney U-test were used for data analysis using Statistical Product and Service Solution (SPSS), version 23. Descriptive statistics included means values of answers (Arikunto, 1989). There were 10 questions to measure farmers' knowledge regarding the use of pesticides; 7 of the

Table 1. The comparison between the implementation of IPM-FFS and Landscape IPM

Indicators	IPM-FFS	Landscape IPM
Pest management unit	Population in one area involving all species of pests	The total population in one area involving one or two species of pests
The coordination of the actors	Farmers in a group	Farmers in a group and between groups as well as with the local government
The duration of the implementation	One growing season	Two planting seasons in a row at the minimum

Source: The Directorate of Food Crop Protection, 2010; the Directorate General of Food Crops, 2015; Trisyono, 2015)

items were measured on four point scale with responses as Disagree (1), Less Agree (2), Agree (3), and Strongly Agree (4); and 3 items were measured on four point scale with responses as Never (1), Occasionally (2), Frequently (3), and Always (4). Attitudes toward the use of pesticides were determined using 10 questions; 4 of the items were measured on four point scale with responses as Never (1), Occasionally (2), Frequently (3), and Always (4); 5 of the items were measured with score for each item ranging from 1 to 4 as Disagree (1), Less Agree (2), Agree (3), and Strongly Agree (4); and one item measure how many times that the farmers spraying chemical pesticides in one planting season. Independent samples t-test was conducted to compare the data between IPM-FFS alumni farmers and Landscape IPM alumni farmers. The Mann-Whitney U-test was also conducted to compare the two groups in terms of their knowledge and attitude toward the use of pesticides (Sugiyono, 2013).

RESULTS AND DISCUSSION

Farmers' Knowledge about the Use of Pesticides

As shown in Table 2, the level of knowledge of all the Landscape IPM alumni farmers regarding the use of pesticides had improved because of their awareness. In general, the farmers were aware that pesticides are used to overcome pests. The majority of farmers of the field schools of both the IPM alumni and the Landscape IPM alumni were already aware of the right time to carry out spraying using chemical pesticides. They used chemical pesticides whenever the pest population exceeded the economic threshold. This is in agreement with the knowledge the farmers had acquired in the field schools on the economic threshold, wherein most of them stated that they were given an understanding of the economic threshold. Mariyono (2007) reported that if farmers do not pay attention to pest attack rates, they tend to use more pesticides than the required amount. Most of the farmers of the IPM alumni do

Table 2. The level of knowledge of the farmers of the IPM alumni and the Landscape IPM alumni regarding the use of pesticides in Klaten regency (no. of IPM alumni farmers = 55; no. of Landscape IPM farmers = 25)

Knowledge Indicators	IPM Alumni		Landscape IPM Alumni	
	Mean	Interpretation	Mean	Interpretation
Pesticides are used according to the type of pest, dose and time appropriate*	2.62	Agree	3.00	Agree
Using chemical pesticides if the pest population is beyond the Economic Threshold*	2.93	Agree	2.72	Agree
Decision to use pesticide based on observation and problem analysis*	2.49	Disagree	2.60	Agree
Wearing a complete protection equipment while applying pesticides*	3.09	Agree	3.60	Strongly Agre
The place for pesticide destruction must be far from the settlement*	3.60	Strongly Agree	4.00	Strongly Agre
Biological agents as an alternative to pesticides*	2.69	Agree	3.00	Agree
The purpose of using chemical pesticides is to overcome the pest attack*	2.64	Agree	2.68	Agree
The Field School given an understanding of Economic Threshold**	2.80	Frequently	3.20	Frequently
Conducting problem analysis before making decision to use pesticides**	2.58	Frequently	3.12	Frequently
Using chemical pesticides if other control components cannot function properly**	2.76	Frequently	2.96	Frequently

Remarks: Real Limits *) 1.00 to 1.74 = *Strongly Disagree*, 1.75 to 2.49 = *Disagree*, 2.50 to 3.24 = *Agree*, 3.25 to 4.00 = *Strongly Agree*;
**) 1.00 to 1.74 = Never, 1.75 to 2.49 = *Occasionally*, 2.50 to 3.24 = *Frequently*, 3.25 to 4.00 = *Always*

not observe and analyze the problem in decision-making to use pesticides. Some farmers use pesticides even for a small-scale pest attack as a preventive measure. Mechanical or biological control will be less practical when the number of pests is still small, that time can be spent for other activities. On the other hand, the Landscape IPM alumni farmers had better knowledge on decision of the use of pesticides.

The knowledge of the Landscape IPM alumni farmers regarding the use of proper protection equipment was higher than that of the farmers of IPM alumni. The farmers of the IPM alumni did not use proper protection equipment while applying pesticides. Some of them were not aware or not well aware about proper protection while applying chemical pesticides in the field. Only 40% of them were highly aware of proper protection equipment. They always wore masks, gloves, hats, and shoes. Regarding the Landscape IPM alumni farmers, 72% of them were highly aware of the forms of protection while applying chemical pesticides. Some of the farmers wore protection equipment while spraying, though they used only some of all the required items. They usually wore only masks, gloves, and clothes. They just knew that while applying pesticides, they should wear protection equipment. Consistent with Bateman's research (2016), farmers in Southeast Asia wear equipment such as masks and gloves as the first step of protection while applying pesticides. The farmers of the IPM alumni and the Landscape IPM alumni already had knowledge regarding a good site for destroying pesticides. In this case, the Landscape IPM alumni farmers had better knowledge. All of the Landscape IPM alumni farmers were aware that the location for destroying pesticides must be away from home and in a specific place. However, almost 78% of the farmers of the IPM alumni knew well about the location for destroying pesticides. It is essential to have knowledge of locations for destroying pesticides destruction to avoid and minimize the risk of pollution from pesticide residues.

Regarding the knowledge of the benefits of using biological agents, it was observed that the knowledge of the Landscape IPM alumni farmers were higher than the farmers of the IPM alumni. The farmers' knowledge of biological agents as an alternative to pesticides also increased after attending the field schools. Consistent with the findings reported by Manoj & Vijayaragavan (2014), after attending the field schools, there was an increase in the farmers knowledge of biological agents and plant-based pesticides. If the farmers have heard about biological agents and have understood the usefulness and benefits of biological agents, it is expected that they would also use biological agents in pest management so that the use of chemical pesticides can be reduced. The farmers of the IPM alumni and those of the Landscape IPM alumni knew that using chemical pesticides can help decrease the pest population. More than 65% farmers of IPM alumni and farmers of the Landscape IPM alumni agreed with the statement that chemical pesticides can be used to overcome pest attack. The farmers who disagreed or strongly disagreed with the statement argued that they used chemical pesticides as a preventive action, not as a control alternative. If this is linked to the last statement (using chemical pesticides if other control components cannot function properly), 69% of the farmers of the IPM alumni and 74% of the Landscape IPM alumni frequently used chemical pesticides as a control alternative when other control components did not function properly. The remaining farmers used chemical pesticides as a preventive action. The Landscape IPM alumni farmers had better skills in conducting problem analysis before making a decision to use pesticides than that of the farmers of the IPM alumni because more than 78% of the Landscape IPM alumni farmers had already frequently applied problem analysis. Regarding the farmers of the IPM alumni, only 64% of them frequently conduct problem analysis.

After attending such field schools as the IPM-FFS and the Landscape IPM, the farmers gained more understanding about identification of the species of pests that attack the plants, so that they can adjust the use of chemical pesticides according to the species of pests. Such IPM training as field schools allows farmers to significantly reduce the use of pesticides because of their improve ability to make decisions regarding pest management (Pouratashi & Iravani, 2012).

Farmers' Attitude toward the Use of Pesticides

The attitude of the farmers toward the use of chemical pesticides is shown in Table 3. The farmers of the IPM alumni used chemical pesticides to control pests and diseases in their field at recommended

Table 3. The attitude of the farmers of IPM alumni and The Landscape IPM alumni toward the use of pesticides in Klaten regency (no. of IPM alumni farmers = 55; no. of the Landscape IPM farmers = 25)

Attitude Indicators	IPM Alumni		Landscape IPM Alumni	
	Mean	Interpretation	Mean	Interpretation
The use of chemical pesticides at the recommended dosage*	3.53	Always	3.28	Always
The implementation of IPM in the field*	2.65	Frequently	3.04	Frequently
Using biological agents*	2.49	Occasionally	2.92	Frequently
Using botanical pesticides*	2.45	Occasionally	2.60	Frequently
The willingness of not using chemical pesticides**	2.45	Disagree	2.64	Agree
Opinion that chemical pesticides are dangerous**	3.22	Agree	3.08	Agree
Chemical pesticides can pollute soil and water**	2.96	Agree	3.12	Agree
Chemical pesticides can cause illness/ diseases**	2.45	Disagree	2.96	Agree
The implementation of IPM that is beneficial**	3.18	Agree	3.20	Agree

Remarks : Real Limits *) 1.00 to 1.74 = *Never*, 1.75 to 2.49 = *Occasionally*, 2.50 to 3.24 = *Frequently*, 3.25 to 4.00 = *Always.*
**) 1.00 to 1.74 = *Strongly Disagree*, 1.75 to 2.49 = *Disagree*, 2.50 to 3.24 = *Agree*, 3.25 to 4.00 = *Strongly Agree.*

dosage. The Landscape IPM alumni farmers also used pesticides at the recommended dosage. Among the Landscape IPM alumni farmers, 76% of them frequently practiced the implementation of IPM in the farmland, and 66% of the farmers of the IPM alumni frequently apply the principles of IPM. This is because some of the respondents were peasants and hence cannot fully make the decision regarding land management actions.

Some of the farmers who had attended the field schools have also implemented the application of pest control technologies such as biological agents and botanical pesticides under the IPM principles. More than 65% of the Landscape IPM alumni farmers have used biological agents and botanical pesticides as a substitute for chemical pesticides for preventing pests and diseases. However, chemical pesticides were still used whenever the pest attacks were considered harmful. On the other hand, 60% of the farmers of the IPM alumni occasionally used biological agents and botanical pesticides. The access to pesticides and the intense promotion of pesticide producers sometimes make farmers difficult to avoid using pesticides. This is in agreement with the research finding of Escalada *et al*. (2009) reporting that the increasing use of pesticides is due to mass media campaigns by pesticide producers in the Mekong Delta, and if they intend to use botanical pesticides or biological agents, they must prepare them first. This is way, sometimes they did not always use botanical pesticides or biological agents.

In general, farmers of the IPM alumni were still not willing to completely stop using pesticides (disagree). According to Erbaugh *et al*. (2010), this finding indicates that the message about reducing pesticide use in the implementation of IPM has not been fully accepted by the farmers. They still liked using pesticides as long as they can afford them. Regarding the negative impacts using chemical pesticides, the farmers of the Landscape IPM alumni agreed with the statement. They realized that chemical pesticides are harmful, can pollute soil and water, and can cause diseases for the users or the consumers of agricultural products exposed to pesticides. Some IPM alumni farmers agreed with the statement that pesticides are dangerous and can pollute soil and water, but still thought that chemical pesticides are do not cause health problems. Most of the farmers in the developing countries are unaware that pesticides are toxic (Oka, 1988). In addition, some farmers are aware of the impact of pesticides on their health and the environment, but they do not wear full protection equipment as they cannot afford it and also because of hot climates (Atreya, 2007).

The IPM alumni farmers and the farmers of the Landscape IPM alumni agreed with the statement regarding the benefits of the application of IPM in farmland. Some farmers who stated that the implementation of IPM is not really useful had quite diverse opinions, the most dominant reason being that the pesticides have faster actions and are more effective and are easier to use. Implementing IPM is less practical, and there is a caution regarding the risk of more pest attacks. One of the obstacles in the adoption of an innovation is the reluctance to face the possible risks (Moyo & Salawu, 2017). However,

most of the Landscape IPM alumni farmers had started implementing IPM in their field and claimed that it is beneficial. They continued spraying pesticides if the pest attack seemed disturbing or if it is beyond the economic threshold using selective pesticides. Berg & Tam (2012) stated that farmers are also aware of reducing the cost of pesticide use by choosing pesticides more selectively and based on the observation of pest conditions in the field.

The intensity of pesticide spraying conducted by the farmers of the IPM alumni and the Landscape IPM alumni is still more than four times in one planting season (Table 4). The farmers who did not spray chemical pesticides at all still comprised only a small proportion of 5.5% of the IPM alumni and 4% of the Landscape IPM alumni. However, some alumni farmers also attempted to reduce the intensity of pesticide spraying to less than three times in one growing season (38.2% of IPM alumni and 44% of Landscape IPM alumni farmers). This effort should be appreciated because they find it difficult to completely avoid spraying chemical pesticides.

The Comparison of Knowledge and Attitude between the Farmers of the IPM Alumni and the Landscape IPM Alumni Regarding the Use of Pesticides

Table 5 shows a difference in the level of knowledge between the farmers of the IPM alumni and those of the Landscape IPM alumni, where the knowledge of the Landscape IPM alumni farmers was higher than that of the IPM alumni farmers. Increasing the knowledge about IPM is the primary prerequisite for the adoption of IPM (David & Asamoah, 2011). The IPM-FFS had been implemented and ended in 2013, while the Landscape IPM were implemented in 2014. In fact, several farmers of the IPM alumni were not able to decrease the use of pesticides as they lacked support from the surrounding environment. This is because other neighboring farmers still carried out conventional cultivation, due to which the IPM alumni farmers were sometimes reluctant to apply IPM principles and return to conventional cultivation of plants. Furthermore, since the IPM principles are rarely applied, most of them did not remember the materials about IPM that they obtained when joining the field schools. On the other hand, since the Landscape IPM alumni was started in 2014 and covered a larger area, the farmers participating in Landscape IPM were more motivated to apply the IPM principles as they practiced the principles together with other neighboring farmers, and the farmers still well remembered the knowledge of IPM. The farmers participating in Landscape IPM were also equipped with various types of training related to IPM outside the regular meetings. More active participation from farmers can improve the knowledge about IPM (Erbaugh *et al*., 2001), especially regarding the appropriate and rational use of pesticides.

The results of the Mann-Whitney U-test showed that there is no difference in attitude between the farmers of the IPM alumni and the Landscape IPM alumni. The attitude of the farmers of the IPM alumni

Table 4. The farmers distribution of chemical pesticides spraying intensity in one planting season in Klaten regency (no. of IPM alumni farmers = 55; no. of the Landscape IPM farmers = 25)

Spraying Intensity	IPM Alumni (%)	Landscape IPM Alumni (%)
>5 times	12.7	4.0
4 - 5 times	43.6	48.0
2 - 3 times	38.2	44.0
Never	5.5	4.0

Table 5. Compare on the knowledge and attitudes of the farmers of the IPM alumni and the Landscape IPM alumni toward the use of pesticides

Indicator	Mean Rank		U	Z	Significance
	IPM Alumni	Landscape IPM Alumni			
Knowledge	35.75	50.95	426.500	-2.731	0.006*
Attitude	37.45	47.2	520.000	-1.752	0.080

Remarks: *significant at $p < 0.05$

and the Landscape IPM alumni indicates that they did not fully agree on the use of pesticides under the IPM principles. The results of the field observation showed that some farmers of the IPM alumni and those of the Landscape IPM alumni thought that pest attack even if it is on a small scale threatens to reduce the amount of crop yield. Consequently, they directly sprayed chemical pesticides in the hope of reducing the loss of yield. This is confirmed by Erbaugh *et al*. (2010) who stated that the decision-making regarding the implementation of IPM by the farmers depends on other factors such as climatic conditions, agro ecosystems, the availability of labor, and market access. In addition, Mariyono (2007) stated that according to the farmers' view, the maximum limit of pest attack can change depending on the price of the product planted and the price of pesticides.

Farmers sometimes still carried out conventional agricultural cultivation because of their decreased trust in the implementation of IPM. This decrease in trust is because they obtained counseling on IPM only while they were attending the field schools; however, after the field schools, they rarely obtained counseling on IPM that can generate confidence in implementing the IPM. Bateman (2016) stated that the causes of the reluctance to apply IPM also include the lack of respect toward the importance of IPM and the reliance on companies, retailers, and others in the business of pesticides. The field schools such as the IPM-FFS and the Landscape IPM can improve and enhance farmers' perspectives in carrying out their farming business under the IPM principles. Although the changes they had experienced are not that real, in fact, some farmers showed positive support for the use of pesticides according to IPM principles. A study on agricultural innovation showed that the knowledge of a technology can be applied if the perception or attitude of the farmers toward the benefits of the technology is positive (Adesina & Zinnah, 1993). Recurrent and long-term counseling patterns are important in changing farmers' behavior, especially in adopting agricultural technologies (Roger, 1995 *cit.* Erbaugh *et al.,* 2010). Implementation of the Landscape IPM with a broader scope of implementation and long-term extension is expected to improve the knowledge and attitude of farmers in the use of pesticides.

CONCLUSIONS

Farmers' knowledge about pesticides (the use, the goals of the use, the protection equipment while using, and the pesticide destruction sites) and about biological agents had improved after attending the field schools. The increase in knowledge of the Landscape IPM alumni farmers was higher than that of the IPM alumni farmers. The knowledge about the economic threshold was also found to be increased in the present research. More than 50% of the farmers of the IPM alumni and the Landscape IPM alumni were aware of the economic threshold. Regarding the knowledge about the basis of decision-making on the use of pesticides and the methods to perform problem analysis, the Landscape IPM alumni farmers were better than those of the IPM alumni farmers. This implies that when making a decision for pest control, they also considered the economic threshold.

The attitude of the farmers of the IPM alumni and the Landscape IPM alumni toward the use of pesticides that the recommended dosage was increased (most of the farmers had followed this). Nevertheless, the intensity of spraying was still quite frequent, being more than three times in one growing season, and several farmers still objected to the absent use of pesticides. regarding the opinion on the dangers of using pesticides, almost all of the Landscape IPM alumni farmers agreed with the statement. Most of the IPM alumni farmers only occasionally or even never used biological agents and botanical pesticides.

Overall, the average level of knowledge of the Landscape IPM alumni farmers regarding the use of pesticides was higher than that of the IPM alumni farmers. However, there was no difference in attitude between the farmers of the IPM alumni and the Landscape IPM alumni. Although the farmers had well acquired the knowledge of IPM principles, applying them seriously is indeed difficult. Implementation of Landscape IPM has the potential to be continued by expanding the area of program implementation. The Landscape IPM program can provide opportunities to improve farmers' knowledge and attitude regarding the use of pesticides. If the understanding of IPM is good and supported by a positive attitude towards IPM technology, farmers are expected to be more wisely in the use of pesticides.

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