Asian Journal of Scientific Research

ISSN 1992-1454

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OPEN ACCESS Asian Journal of Scientific Research

ISSN 1992-1454
DOI: 10.3923/ajsr.2019.105.111

Research Article
Farmers' Knowledge and Attitudes Towards the Integrated Pest Management Principles in Paddy Rice in Banyumas Regency

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Abstract

Background and Objective: Integrated Pest Management (IPM) is an ecological approach of pest control method in agricultural crop management. One way to disseminate information on IPM is through farmer field schools activities. The purpose of this research was to find out the knowledge and attitudes of farmers who had participated in the Integrated Pest Management-Farmer Field Schools (IPM-FFS) towards the use of pesticides following the IPM principles. **Materials and Methods:** This research employed a survey method with 55 farmers of IPM-FFS alumni and 40 farmers of non-IPM-FFS as the respondents. A descriptive analysis was carried out to describe farmers' knowledge and attitudes towards the use of pesticides. The Mann-Whitney U-test was performed to compare the level of knowledge and attitudes between the IPM-FFS farmers and the non-IPM-FFS farmers towards the use of pesticides following the IPM principles. **Results:** The results showed that the IPM-FFS farmers in Banyumas indicated sufficient understanding of the use of pesticides as suggested by the IPM principles and indicated some agreement to the use pesticides following the IPM principles. **Conclusion:** Farmers' knowledge and attitudes towards the use of pesticides in accordance with the principles of IPM can be increased more effectively through the IPM-FFS approach.

Key words: IPM-FFS alumni, farmer field schools, integrated pest management, knowledge and attitude, use of pesticides

Received: October 08, 2018 Accepted: November 12, 2018 Published: December 15, 2018

Citation: Andriarti Kusumawardani, Edhi Martono, Yohanes Andi Trisyono and Nugroho Susetyo Putra, 2019. Farmers' knowledge and attitudes towards the integrated pest management principles in paddy rice in banyumas regency. Asian J. Sci. Res., 12: 105-111.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Integrated Pest Management (IPM) is agricultural management that aims to minimize pest attacks naturally and at the same time, reduce the danger of chemical pesticides on humans, plants and the environment[1]. Integrated Pest Management-Farmer Field Schools (IPM-FFS) are one of the programs carried out to support the implementation of IPM in Indonesia[2]. The expected results from IPM-FFS are knowledge enhancement and decision making skills by farmers. It is also expected to reduce the use of pesticides, increase production and ultimately increase economic benefits[3]. Agricultural extension programs and farming education such as IPM-FFS are the main instruments of the government policy to improve agricultural productivity by using environmentally friendly control methods[4].

Integrated Pest Management (IPM) is a technology through which farmers experience several stages of changes of knowledge and attitude building. 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[5]. 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. 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[6]. The duration of the IPM-FFS implementation is only one planting season. 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[7].

Farmer education through field schools is a fairly effective approach that can be used to deliver knowledge to be applied by farmers[4]. Bloom theory cit. Iskandar[8] stated that knowledge is the initial stage of perception which then generates attitudes and results in actions. The attitude of a person toward an object is a supportive or a non-supportive feeling about the object[9], in this case, the use of pesticides following the IPM principles.

One of the locations to implement IPM-FFS in Indonesia is Banyumas, which is a center of rice production and is an area that is vulnerable to rice pest attacks. Thus, for this reason, this location was chosen for the implementation of farmer field schools activities. This article discusses the knowledge and attitudes of farmers in Banyumas who have joined IPM-FFS towards the use of pesticides. It tries to identify whether there is an increase in knowledge and changes in the attitudes of the IPM-FFS farmers towards the use of pesticides as suggested by the IPM principles.

MATERIALS AND METHODS

This research was conducted in the form of a survey from June-August, 2017. The locations of the research were selected using the purposive sampling method[10]. They were centers of rice cultivation in Banyumas Regency, Central Java covering 4 districts, those that had implemented SLPHT. They are Jatilawang, Kesugihan, Rawalo and Kembaran. The total number of respondents was 95 people of 55 farmers who had attended IPM-FFS and 40 non-IPM-FFS farmers for comparison.

The type of the data was primary collected directly from the respondents using questionnaires and interviews. Descriptive analysis and Mann-Whitney U-test were used for data analysis using Statistical Product and Service Solution (SPSS), version 23. There were 7 questions to measure farmers' knowledge about the use of pesticides and 10 questions to determine their attitudes. Each item of the questions had 4 options with the scores of 1-4. The results of the answers for each score category were counted in percentage so that the proportion of each answer could be identified. The Mann-Whitney U-test was performed to find out the different attitudes between the IPM-FFS farmers and the non-IPM-FFS farmers towards the use of pesticides following the IPM principles[11].

RESULTS

Farmer profile: In general, the IPM-FFS and no-IPM-FFS farmers indicated a similar profile. The fairly sharp difference was about levels of education where the percentage of the IPM-FFS farmers who had middle school and high school level education was found greater. Most of the IPM-FFS and non-IPM-FFS farmers in Banyumas were over 40 years old. This showed that the farmers aged more than 40 were more active in rice cultivation activities than those under 40. Most IPM-FFS farmers and non-IPM farmers had less than 0.5 ha of cultivated area. The respondents in Banyumas generally had more than 10 years of farming experience and grew rice continuously throughout the year (Table 1).

Farmers' knowledge about the use of pesticides as suggested by the IPM principles: Based on Table 2, the knowledge of the IPM-FFS farmers in Banyumas about the use

Table 1: Rice farmers' characteristic in Banyumas, Central Java

	IPM-FFS (n = 55)		Non-IPM-FFS (n = 40)	
Variables	Frequency	Percentage	Frequency	Percentage
Age of farmer (years)				
20-30	0	0.0	3	7.5
31-40	8	14.5	4	10.0
41-50	14	25.5	13	32.5
51-60	18	32.7	11	27.5
>61	15	27.3	9	22.5
Level of education				
Primary	12	21.8	18	45.0
Middle school	18	32.7	11	27.5
High school	21	38.2	11	27.5
College	4	7.3	0	0.0
Land tenure (ha)				
<0.2	23	41.8	26	65.0
0.2-0.5	22	40.0	12	30.0
0.6-1	5	9.1	2	5.0
>1	5	9.1	0	0.0
Farming experience (year)				
<5	3	5.0	4	10.0
6-10	14	25.0	6	15.0
11-15	10	18.0	6	15.0
16-20	11	20.0	6	15.0
>20	17	31.0	18	45.0
Cropping pattern				
Rice-rice	47	85.5	25	62.5
Rice-non rice	8	14.5	15	37.5

Table 2: Knowledge of the farmers regarding the use of pesticides in Banyumas, Central Java (%)

	IPM-FFS				Non-IPM-FFS			
Knowledge indicators	DU	PU	QU	VU	DU	PU	QU	VU
The use of chemical pesticides	0.0	5.5	80.0	14.5	5.0	32.5	57.5	5.0
The benefits of using botanical pesticides and biological agents	0.0	9.1	74.5	16.4	7.5	22.5	62.5	7.5
The meaning of economic threshold	0.0	30.9	65.5	3.6	37.5	27.5	32.5	2.5
The benefit of wearing a complete protection equipment while applying pesticides	0.0	5.5	9.1	85.5	2.5	10.0	10.0	77.5
Proper pesticide storage	1.8	1.8	7.3	89.1	5.0	0.0	20.0	75.0
The definition of chemical pesticides	1.8	7.3	76.4	14.5	7.5	10.0	80.0	2.5
Knowing about IPM activities	0.0	7.3	72.7	20.0	27.5	35.0	37.5	0.0

DU: Do not understand, PU: Poorly understand, QU: Quite understand, VU: Very well understand

of pesticides following the IPM principles was still limited to "quite understand". It could be seen from the results that several indicators of knowledge that required special skills were poorly understood, while knowledge that had often been obtained was very well understood by the farmers. Percentage of IPM-FFS farmers who understand the usefulness and definition of chemical pesticides was higher than non-IPM-FFS farmers. The knowledge of the IPM-FFS farmers about the meaning of the Economic Threshold (ET) showed the lowest percentage of understanding compared to the other knowledge indicators. The way of handling chemical pesticides is very well understood by the farmers because chemical pesticides are one main material other than fertilizers and seeds used for their rice cultivation activities in their lands. Knowledge of what activities are carried out in IPM is quite understood by most of the IPM-FFS farmers. This indicated that the farmers participating in the IPM-FFS activities were interested in the information about IPM technology.

Farmers' attitudes towards the use of pesticides as suggested by the IPM principles: In general, the IPM-FFS farmers showed more supportive attitudes towards the use of pesticides following the IPM principles than the non-IPM-FFS farmers (Table 3). The use of chemical pesticides to overcome pests and diseases attack is supported by most of the non-IPM-FFS farmers. This is because they consider that the presence of pests and diseases in their lands is an attack so that it is necessary to use pesticides.

Table 3 : Attitude of the farmers toward the use of pesticides in Banyumas, Central Java (%)

	IPM-FFS				Non IPM-FFS			
Attitude indicators	SD	D	A	SA	SD	D	A	SA
Pesticides are used according to the type of pest, dose and time appropriate	0.0	5.5	80.0	14.5	5.0	32.5	57.5	5.0
The purpose of using chemical pesticides is to overcome the pest attack	5.5	34.5	54.5	5.5	2.5	15.0	72.5	10.0
Decision of using chemical pesticides after they conduct observations and problem analyses	0.0	81.8	10.9	7.3	7.5	65.0	22.5	5.0
The destruction of the pesticide residues away from the settlement	3.6	0.0	7.3	89.1	5.0	0.0	37.5	57.5
The idea of not using chemical pesticides	1.8	36.4	45.5	16.4	15.0	17.5	55.0	12.5
Chemical pesticides can cause health problems	1.8	7.3	76.4	14.5	7.5	10.0	80.0	2.5
Opinion that chemical pesticides are dangerous	0.0	7.3	65.5	27.3	10.0	72.5	15.0	2.5
Chemical pesticides can contaminate soil and water	0.0	10.9	67.3	21.8	2.5	75.0	17.5	5.0
The use of chemical pesticides if the pest population is greater than the natural enemies	16.4	14.5	67.3	1.8	12.5	30.0	50.0	7.5
Chemical pesticides can pollute agricultural products	3.6	0.0	56.4	40.0	7.5	22.5	57.5	12.5

SD: Strongly disagree, D: Disagree, A: Agree, SA: Strongly agree

Table 4: Compare on the knowledge and attitudes of the farmers of the IPM alumni and the non IPM toward the use of pesticides

	Mean rank			
Variables	IPM-FFS	Non-IPM-FFS	U-test	Significance
Knowledge	60.07**	31.40	436.000	0.000
Attitude	59.36**	32.38	475.000	0.000

**Significant at p<0.05

There is an interesting finding that can be seen about the attitude of the farmers towards the decision of using chemical pesticides after they conduct observations and problem analyses. The percentage of the IPM-FFS farmers who agree to use chemical pesticides is less than the non- IPM-FFS farmers. This difference was due to the differences in their basic knowledge. Both IPM-FFS and the non-IPM-FFS farmers agree that chemical pesticides can cause health problems. Not all of the IPM-FFS farmers support the idea of not using chemical pesticides and using chemical pesticides if the pest population is greater than the natural enemies.

Comparison of knowledge and attitudes between the IPM-FFS farmers and non-IPM-FFS farmers towards the use of pesticides following the IPM principles: The results of the Mann-Whitney U-test analysis showed that the knowledge and attitudes of the IPM-FFS farmers towards the use of pesticides following the IPM principles were better than that of the non-IPM-FFS farmers (Table 4). The farmers who have participated in the IPM-FFS activities have understood the concept of IPM and have started using pesticides appropriately and rationally following the IPM principles.

DISCUSSION

The present study explored the knowledge and attitude of farmers who have joined field schools towards the use of pesticides following the IPM principles in Banyumas, Central Java, Indonesia. Studies on this topic are limited, many researchers only focused on increased farmers' knowledge after training when studying field school. Findings of this study also showed that the attitude of farmers who have participated in IPM-FFS in the use of pesticides according to the IPM principle to be better. The level of education influenced the ability of farmers to receive new information and technological innovations. According to Erbaugh *et al.*[12], the adoption of information related to a particular technology was influenced by the level of education. Yasuoka *et al.*[13] stated that the success of basic training activities on participants' knowledge was influenced by the level of education they had. Most of IPM-FFS farmer have middle and high school education level. To attend IPM-FFS also requires adequate reading and writing skills[6].

Overall, the level of knowledge of the IPM-FFS farmers about the use of pesticides following the IPM principles was higher than that of the non-IPM-FFS farmers. Generally, all of the farmers know that pesticides were used to control pests and diseases but not all of the farmers especially those who had never attended IPM-FFS know the types of pesticides that were suitable for the target pests. It explained that farmer field schools could increase farmers' knowledge. This was in line with a research carried out by Manoj and Vijayaragavan[14] that showed that after farmers participated in farmer field schools, their knowledge about biological agents and botanical pesticides increased.

Most farmers showed the lower knowledge about The Economic Threshold. The economic threshold was the boundaries made to overcome pest and plant diseases. To determine the economic threshold requires stages including

the determination of pest population density, the determination of the amount of losses due to pests and a study on the correlation between population density and damage that required calculation and analyses[15]. Since the IPM-FFS farmers in Banyumas were mostly over 40 years old, the ability to receive new and complex information had decreased. This was in line with a research carried out by Ali and Sharif[16] that showed older farmers tend to be less sensitive to new ideas than young farmers. Beside that, the implementation of IPM-FFS which was only one planting season, affected the ability of farmers to understand complex information such as ET. This results in the difficulty to remember the knowledge about economic threshold. This is only a few farmers who attended in the IPM- FFS understand the economic threshold[17].

Findings of this study showed that information on IPM that was just known (e.g., Economic Threshold) was not understood by farmers even though they had attended IPM-FFS. Knowledge which has known previously such as the use of pesticides, farmers who attended IPM-FFS become more aware of to use pesticides properly. This indicates that the IPM-FFS which is carried out only one planting season (about 16 weeks) is too short. It is recommended that IPM-FFS be implemented in several planting seasons or carried out accompaniment as a follow-up with wider area coverage. According to Yang *et al.*[18], farmers who participate in field schools in the long term, allow them to learn simply but the knowledge acquired was very complete.

The IPM-FFS who have understood how to determine the economic threshold find it complicated to apply chemical pesticides so that only a small percentage of the IPM-FFS farmers support this attitude. On the other hand, the non-IPM-FFS farmers have not understood much about the meaning of the economic threshold. Therefore, the observations and problem analyses they perform are based on their beliefs without considering the economic threshold. When the non-IPM-FFS farmers think that pest attacks have occurred, they will decide to use pesticides based on the schedule. This is consonant with the findings of a research conducted by Irham and Mariyono[19] that showed that the decision to use pesticides among the IPM-FFS farmers is different from that of the non-IPM-FFS farmers.

However, even though the non-IPM-FFS farmers know that chemical pesticides can cause health problems, they are not worried about it. This finding is similar to that found by Jallow *et al.*[20], farmers were well aware of the harmful effects of pesticides with regards to the environment and human health but they are still dependent on pesticides use. Farmers assumed that chemical pesticides only pollute agricultural products and can be removed by washing. In line with Berg and Tam[21] finding, that some rice farmers in the Mekong Delta do not care with negative effect of pesticides on the yield and environmental.

Farmers who have attended IPM-FFS are still doubts to fully implement the IPM principles. According to Erbaugh *et al.*[12], this phenomenon shows that the message about reducing the use of pesticides in the application of IPM has not been fully accepted by the farmers. One of the obstacles in the adoption of an innovation is the reluctance to face the possible risks[22]. In line with the results of the study conducted by Sadat and Chakraborty[23], the farmers choose to use chemical pesticides because they have a faster deadly effect. In addition, chemical pesticides are easier to obtain, store and use and in certain conditions they are cheaper. Therefore, it is not easy to shift pesticides with other technologies that are more environmentally and health friendly[24].

As the results show, farmers who attended IPM-FFS 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. According to Escalada *et al.*[25], the lack of repetitions and follow-up after intensive IPM training would result in high discontinuance. Bateman[26] stated that real IPM is not being widely practiced by farmers for a number of reasons. Possibly the first of these has been a failure to appreciate the importance of and engage with, pesticide companies, retailers and others.

Even though the IPM-FFS farmers have not fully applied the knowledge they have obtained, the knowledge and attitude towards the use of pesticides according to the principle of IPM is better. It can be said that farmer field schools activities or IPM meetings tend to increase knowledge and improve farmers' attitudes towards the use pesticide following the IPM principles. Trainings in farmer field schools tend to change the attitudes of farmers to adopt IPM technology and to have better attitudes towards IPM compared to farmers who have not attended the trainings[27]. The field schools such as the IPM-FFS can improve and enhance farmers' perspectives in carrying out their farming business under the 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[28].

CONCLUSION

The IPM-FFS farmers in Banyumas have sufficient understanding about the use of pesticides as suggested by the IPM principles and show some agreement to use pesticides based on the IPM principles. The IPM farmer field school activities can increase knowledge and improve farmers' attitudes towards the use of pesticides to follow the IPM principles. Implementation of the IPM-FFS 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.

SIGNIFICANCE STATEMENT

This study found the IPM-FFS that can be beneficial for improvement the knowledge and attitude of farmers towards IPM principles. The information will be of great value to policy maker, especially Indonesia Ministry of Agriculture to continue and developed the program. This study will help the researcher to uncover the critical areas of the dissemination of IPM information that many researchers were not able to explore. 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.

ACKNOWLEDGMENT

We would like to thank to Banyumas District Agricultural Office for giving permission and the farmers in Jatilawang, Kesugihan, Rawalo and Kembaran for their help. This manuscript is part of dissertation entitled "Dampak Pengelolaan Hama Terpadu Terhadap Penggunaan Pestisida di Jawa Bagian Tengah".

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