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Exploring Farmers' Knowledge and Awareness in Employing Beneficial Plants for Paddy Pest Management in Besut, Terengganu

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ABSTRACT

The presence of beneficial insects such as parasitoids and predators in paddy fields is very important as such insects help in pest population management and reduce pesticide use. To ensure beneficial insects are sustained in the field, their food source and shelter must always be sufficient, therefore, ecological engineering techniques can be applied. This idea encompasses plant management through habitat manipulation, which help support biological pest control operations by encouraging the growth of beneficial plants in the fields that serve as a source of food and shelter to beneficial insects. However, the knowledge and awareness of local farmers, especially in Besut, Terengganu used this biological control technique in managing paddy pests are still unknown. Therefore, the main purpose of this study was to determine the level of knowledge and awareness of paddy farmers on the use of beneficial plants in controlling paddy pests among paddy farmers in Besut, Terengganu. This quantitative research design study used questionnaire by face to face with 56 paddy farmers as the main respondents. Based on the survey, the paddy cultivation in Besut was dominated by middle-aged male farmers which 76.8% of them have secondary education with more than 20 years of paddy cultivation experience. Results showed that most of the farmers have a moderate level of knowledge (67.9%) and awareness (73.4%) about the use of beneficial plants in controlling paddy pests. Therefore, it is necessary to hold a continuous awareness program by local authorities about the importance of using beneficial plants in paddy fields in the future.

Keywords: Beneficial plant; biological control; farmers awareness; paddy pests

INTRODUCTION

Rice farming plays a crucial role in national development, not only as a primary source of staple food but also as a major employer, particularly for a significant portion of the rural Malaysian population. Consequently, government efforts will continue to be directed at strengthening the paddy and rice industries of the country, particularly through higher productivity and quality of paddy and rice harvests (Yasar et al., 2016). Unfortunately, insect pests constitute one of the major yield-reducing factors in rice (Alibu et al., 2016). Resistance to insecticides, herbicides, and other pesticides has resulted in increased application rates, higher crop losses, and

escalating expenses for farmers who have become trapped on a pesticide treadmill (Pimentel, 2005). Thus, it brings various negative effects such as the effects of food poisoning humans, complications to the skin, nerves and systems of the human body, in addition to harming the environment by polluting clean water and air sources (Haliza, 2021).

Based on the issues, the utilisation of beneficial plants in paddy fields are one of the smart strategies for managing paddy pests in the fields. It is becoming increasingly common to utilise beneficial plants in rice fields since they are natural plant that provides food (i.e nectar) and shelter for beneficial insects such as parasitoids and predators (Sugiharti et al., 2018). Therefore, the plants such as moss rose, cosmos, sunflowers, and *Turnera* spp. have been looked at for their health benefits (Sugiharti et al., 2018). This idea encompasses cultural techniques such as vegetation management through habitat manipulation, also known as the ecological engineering concept which assists to support biological pest control operations by encouraging the growth of beneficial insects (Lu et al., 2015).

Beneficial plants have the potential to extend lives and improve the productivity of natural enemies of pests while having no detrimental influence on other pests. It is critical to research the role of beneficial plants in order to ensure and increase the efficiency of natural enemies (Jamian, 2017). This practice has been shown to increase the diversity of arthropods in paddy fields, especially natural enemy species that indirectly contribute to reducing the rate of pest infestation (Hamdan et al., 2023). However, the knowledge and awareness level of its application in paddy among local farmers is still unknown. Therefore, this research was carried out to better understand the degree of knowledge and awareness among farmers in Besut, Terengganu, regarding the application of this control technique in paddy fields.

MATERIALS AND METHODS

Study area and sampling method

The study was conducted in Besut, a district situated in Terengganu, Peninsular Malaysia. The paddy farmers in Besut are under the management and monitoring by the North Terengganu Integrated Agricultural Development Area (IADA KETARA). The IADA KETARA area encompasses both the Besut and Setiu districts in the state of Terengganu. Besut district (122,831 hectares) and Setiu district (122,212 hectares) were both included in the overall project's coverage area of 208,212 hectares (85,381.70 hectares) (Siwar et al., 2013). In 2022, the paddy area under IADA KETARA management were reported at 9,752 hectares with 43011 metric tonnes of production (Jabatan Pertanian Malaysia, 2023).

Research sampling and data collection

This study employed a face-to-face questionnaire survey method with 56 paddy farmers as main respondents provided by IADA KETARA. The data had been gathered through the use of a primary source known as primary data and secondary source. Primary data which was data gathered by survey methods in the form of questionnaires which consisted three main sections (i.e. demographic profile, level of knowledge and level of awareness). This survey assisted in providing a better understanding for this researched and served as a guide in the development of a structured questionnaire that was used to collected primary data. Data collection was conducted face-to-face with the farmers at IADA KETARA headquarters in June 2022.

For secondary sources, the information is gathered by reading relevant documents from a variety of sources, such as books, newspapers, articles, reports, journals, and online resources, among other things. These documents contribute to a better understanding of this study and serve as a guide to develop a systematic questionnaire to collect primary data.

Sampling method that was used in this study is simple random sampling. A simple random sampling is a subset of a population that is chosen at random. Using this sampling method, each person in the population has the same chance of being chosen. This method was chosen because it takes the least time out of all the ways to sample.

Data analysis

Descriptive analysis was used to determine the level of knowledge and awareness on the usage of beneficial plants among paddy farmers in Besut and regression analysis was used to predict the contribution of knowledge and awareness on the usage of beneficial plants in controlling paddy pests among farmers in Besut, Terengganu. The data had been analysed with the Statistics Package for Social Science Software (SPSS) version 20.

RESULTS AND DISCUSSION

Socio-demographic profile of paddy farmers

The socio-demographic profile of 56 paddy farmers in Besut, Terengganu was shown in Table 1. The survey found that most paddy farmers were aged 51 to 60 years, which accounted for 32 percent of the respondents. The second highest age for farmers is from 31 to 40 years and 41 to 50 years, accounting for the same percentage of 25 percent. Next is from 21 to 30 years old which accounts for 11 percent, 61 to 70 years old accounts for 5 percent and the lowest age percentage of farmers were from 71 years old and above which accounts for 2 percent only. According to the Department of Statistics Malaysia (2020), there are three age groups in Malaysia; young age (0 to 14 years), median age (15-64 years) and old age (65 years and above). Data from the survey shows that most of the respondents were in the median age group. These results show that in this survey, there was a lack of involvement from older farmers. This may happen because of age and health factors that restrict older farmers to handle this job which causes the involvement of the median generation more than the older generation. Nevertheless, this data also illustrates that many median generations have started to get involved in paddy farming activities.

From the survey, the data shows that 76.8 percent of farmers are from secondary school which represents the highest percentage of respondents. The second highest is from primary school which is 16.1 percent of the respondents. While only 7.1 percent of the respondents are from universities. The educational level among farmers showed that the majority of farmers had been educated to the secondary school level. Because the majority of paddy farmers are in secondary school, it demonstrates that their proclivity to understand and adapt biological control methods is only moderate. Their knowledge and awareness of beneficial plants are limited. Farmers with a higher level of education may be better able to understand and aware of the importance of biological control methods.

Table 1. Socio-demographic profile of paddy farmers in IADA KETARA (n=56)

No.	Socio-demographic profile of paddy farmers	Group label	Frequency	Percentage (%)
1.	Age	21 - 30 years	6	11
		31 - 40 years	14	25
		41 - 50 years	14	25
		51 - 60 years	18	32
		61 - 70 years	3	5
		71 and above	1	2
2.	Highest level of education	No education	0	0
		Primary school	9	16.1

		Secondary school	43	76.8
		Diploma/certificate	4	7.1
3.	Year of starting paddy cultivation	<2000	28	50
		2001 - 2010	13	23.2
		2011 - 2020	15	26.8

This survey also shows that 50 percent of the paddy farmers, which is half of them, have twenty years of experience and above in rice farming. While 26.8 percent of farmers have more than ten years of experience. Only 23.2 percent of paddy farmers have less than ten years of experience. The number of years shows that most paddy farmers are experienced farmers which cultivated by middle-aged male farmers. Most of them have secondary education with more than 20 years of rice cultivation experience. This study finding was similar to Sabran and Abas (2021) recorded the most experience level among the paddy farmers in Penang was between 11 to 19 years and dominated by middle-aged male farmers. Similarly, the paddy fields are dominated by middle-aged male farmers who mostly have secondary school education and more than 20 years of experience in Pasir Mas, Kelantan (Abas et al., 2020) and Melaka (Fairuz et al., 2017).

Level of knowledge on the usage of beneficial plants among paddy farmers

According to the findings presented in Table 2, the majority of farmers (67.9%) demonstrated a moderate level of knowledge regarding the use of beneficial plants in managing paddy pests. On the other hand, Table 3 revealed that farmers had a high level of knowledge (as evidenced by the highest mean score of 3.93) about the environmental friendliness and sustainability of using beneficial plants. However, the lowest mean score of 3.66 was related to farmers' knowledge about the specific types of beneficial plants that can be used, although this score still reflected a moderate level of understanding. The results suggest that there is a need for further guidance and support from relevant parties to encourage paddy farmers to utilize beneficial plants and other biological control methods in rice farming activities.

Table 2. Level of farmer's knowledge in the usage of beneficial plant (n=56)

Variable	**Level (%)**			**Mean**	**SD**
	Low	Moderate	High		
Knowledge	14.3	67.9	17.9	36.25	6.70

Note: Computed Scores of Descriptive Statistics: Mean= Summated Mean; SD= Standard Deviation.

Furthermore, there are scientific studies that have proven the benefits of applying beneficial plants such as *Turnera* plants in rice fields as studied by Amzah et al. (2018), Muniruddin et al. (2022) and Hamzah et al. (2023). By taking these examples, it is hoped that it will further increase farmers' knowledge and confidence about the benefits of using beneficial plants in their paddy fields. Nonetheless, Sun et al. (2022) stated that some demographic and household characteristics also significantly influence their willingness to adopt biological control of IPM in managing pests. They also suggested that increasing farmers' agricultural production knowledge, especially knowledge about pest management, is essential in promoting IPM technology. Besides this, IPM technology should be promoted purposely and consciously, combined with farmers' individual and family characteristics.

Table 3. Mean level of knowledge by statements (n=56)

Statement	Mean	SD	Level of Knowledge (%)				
			1	2	3	4	5
I know the existence of beneficial plants	3.71	1.07	1.8	16.1	16.1	41.1	25
I know the utilisation of beneficial plant is more cost-effective	3.73	1.15	7.1	7.1	17.9	41.1	26.8
I know the use of beneficial plant is more environmentally friendly and sustainable	3.93	1.04	3.6	7.1	14.3	42.9	32.1
I know if chemical pesticides can be reduced, the paddy ecosystem can be protected and conserved	3.77	1.06	3.6	10.7	16.1	44.6	25
I know beneficial plant can help to enhance the quality of paddy	3.84	1.17	8.9	3.6	12.5	44.6	30.4
I know using beneficial plants takes time to be effective	3.75	1.11	7.1	7.1	12.5	50	23.2
I know the types of beneficial plants that can be used	3.66	1.30	12.5	5.4	14.3	39.3	28.6

Likert-like Scale Levels of Knowledge: 1-No Knowledge, 2- Very Low Knowledge, 3-Low Knowledge, 4-Moderate Knowledge, 5-High Knowledge; Mean= Summated Mean; SD= Standard Deviation.

Level of awareness on the usage of beneficial plants among paddy farmers

Table 4 displays the majority of paddy farmers (73.4%) had a moderate level of awareness regarding the use of beneficial plants in managing paddy pests. Nevertheless, Table 5 indicates that farmers had a high level of awareness (as demonstrated by the highest mean score of 3.88) about the ability of beneficial plants to reduce pest populations. However, the lowest mean score of 3.64 was related to farmers' awareness about the application of beneficial plants in paddy fields and sources of information on beneficial plants, although this score still reflected a moderate level of understanding. Overall, the paddy farmers in Besut, Terengganu exhibited a moderate level of awareness regarding the use of beneficial plants in managing paddy pests, particularly with regard to reducing pest populations and identifying sources of information on beneficial plants. It is possible that this is influenced by their low level of education. Similarly, Fairuz et al. (2017) found that the level of awareness is insufficient among paddy farmers regarding the empowerment of biological control in paddy fields in Melaka. They stated that knowledge, attitude and communications gave a significant effect to the practices of the farmers towards enhancing the natural enemies in rice fields. Therefore, they suggested the need for a continuous awareness program by local authorities regarding natural enemies in paddy fields in the future.

Table 4. Level of awareness in the usage of beneficial plant (n=56)

Variable	Level (%)			Mean	STD
	Low	Moderate	High		
Awareness	14.3	73.4	12.5	22.54	4.45

Note: Computed Scores of Descriptive Statistics: Mean= Summated Mean; SD= Standard Deviation.

Table 5. Mean level of awareness by statements (n=56).

Statement	Mean	SD	Level of Awareness (%)				
			1	2	3	4	5
I am aware of biological control method in controlling paddy pests	3.71	0.85	0	10.7	21.4	53.6	14.3
I am aware of other method in controlling paddy pests	3.82	0.77	1.8	5.4	12.5	69.6	10.7
I am aware of sources of information on beneficial plants	3.64	0.92	5.4	1.8	28.6	51.8	12.5
I am aware of beneficial plant application in paddy field	3.64	0.92	5.4	1.8	23.2	62.5	7.1
I am aware of usage of beneficial plants will reduce the pest populations	3.88	0.87	3.6	5.4	14.3	53.6	23.2
I am aware of the benefits of adopting beneficial plants in paddy fields	3.84	0.79	1.8	7.1	7.1	73.2	10.7

Likert-like Scale Levels of Awareness: 1-No at all aware, 2- Slightly Aware, 3-Not Sure, 4-Moderate Aware, 5-Extremely Aware; Mean= Summated Mean; SD= Standard Deviation.

Contribution of knowledge and awareness on the usage of beneficial plants among paddy farmers

The dependent variable in this analysis were paddy farmers' awareness of the usage of beneficial plants, while the independent variable was that knowledge among paddy farmers in Besut, Terengganu. From the data in the model summary, the R-square valued was 0.627. Therefore, it means that 62.7% of paddy farmers' awareness could been explained by their knowledge about the importance of beneficial plants while another 37.3% may been from other factors. The ANOVA test used to determine whether the model in used was significant was shown in Table 6. The model was significant since the significance threshold was 0.000, which was smaller than 0.05.

Table 6 shows the level of significance for the independent variable, which was the level of paddy farmers' knowledge of beneficial plants. In this analysis, to determine the significant level, the significant valued must been less than 0.05 and the level of knowledge of farmers had a significant effect on the awareness of farmers in applying beneficial plants among paddy farmers because the significant valued was 0.000. This result shows that the level of farmers' knowledge about the use of beneficial plants affects the level of farmers' awareness as well. If they did not have a high level of knowledge about the use of beneficial plants then they did not have a high awareness of the importance of using beneficial plants in controlling paddy pests.

Furthermore, the findings from this study show that knowledge and awareness contribute significantly to the use of beneficial plants among rice farmers in Besut. Farmers with a higher level of awareness of the benefits of using these plants such as natural pest control, soil improvement, and water conservation, which more likely to adopt sustainable agricultural practices. This supports the notion that education and awareness campaigns can be important in promoting the wider use of beneficial plants in the region.

Table 6. Model summary, ANOVA table and coefficients of the final model on knowledge and awareness among paddy farmers

Model	R	**R^2**	Adjusted R^2	Change Statistic		
				R^2Change (ΔR^2)	F Change	Sig F. Change
1	0.792[a]	**0.627**	0.620	0.627	90.792	.000

ANOVA Table for Final Model

Model	Sum of Square	df	Mean Square	F	Sig.
Regression	682.187	1	682.187	90.792	**.000**
Residual	405.742	54	7.514		
Total	1087.929	55			

Coefficients of the Final Model

Model Variables Entered	B	SE	Beta	t	Sig	Collinearity
						Tolerance
Constant	9.051	1.462		6.192	.000	
Knowledge	0.511	0.054	.792	9.528	**.000**	1.000

When compared with previous studies, our findings are consistent with Mohamed et al. (2016), who found that higher levels of knowledge among farmers in Kedah were directly linked to the increased adoption of sustainable agricultural practices. However, Mohamed et al. (2016) focused broadly on sustainable methods, whereas our study narrows down to the specific use of beneficial plants, providing a more specialized look into the dynamics at play within the farming community in Besut. In contrast, Terano et al. (2015) reported that despite high awareness, the adoption rate of sustainable practices was low due to cultural resistance and traditional farming preferences. They found that some paddy farmers in Kelantan are still not aware of or do not understand the importance of the environmental conservation and the concept of sustainability in agriculture. Our study, however, reveals that the farmers in Besut appear more open to integrating beneficial plants into their farming systems, which might suggest regional differences in mindset or more effective outreach programs in this area. It could also indicate that local factors, such as peer influence or the accessibility of beneficial plants, play a more prominent role in shaping attitudes.

CONCLUSION

In conclusion, the study found that paddy farmers in Besut, Terengganu have a moderate level of knowledge and awareness about the use of beneficial plants in controlling paddy pests. However, they still prefer to use insecticides because of the faster and more efficient results. Therefore, it is important for government agencies to increase farmers' knowledge and awareness about the benefits of using beneficial plants in paddy fields. This will not only reduce the negative environmental impacts of pesticide use but also improve the quality of paddy crops and promote sustainable agriculture practices.

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