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Farmers' Adoption Level of Integrated Pest Management of Rice Paddy Crops in Tegineneng District, Regency Pesawaran

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Abstract— Attacks by plant pest organisms reduce global crop production by up to 40%, causing losses to farmers. If this is sustained, it will have a negative impact on the country's economy and food security. Therefore, efforts are needed to anticipate it by promoting technology that is more efficient, economical, and environmentally friendly. One of the efforts to increase production can be done through an integrated pest control system (IPM) (FAO, 2022). This study aims to determine the level of adoption of farmers in IPM of paddy rice plants. The data analysis used is descriptive quantitative, the presentation of this data is intended to categorise and reveal important information about the level of adoption of farmers in integrated pest control of paddy rice plants. The level of adoption of farmers in IPM in the medium category, in other words, farmers have not fully adopted IPM. In the principle of healthy plant cultivation, farmers have used superior seed varieties, carry out seed nurseries, make planting distance arrangements, and carry out fertilisation. In the element of natural enemy utilisation, farmers have not utilised natural enemies. In the element of routine observation, farmers carry out observations at least once a week. In the element of farmers as IPM experts, farmers are quite capable of making, applying and using vegetable pesticides in accordance with the dose recommended by the extension agent.

Keywords— Adoption; Rice; Pht;Farmers; Sl-Pht

I. INTRODUCTION

Achieving adequate food availability, especially rice at affordable prices, has become the main focus of agricultural development policy. This is because rice is a basic need for the Indonesian population, acting as a source of energy and carbohydrates. In addition, rice is also a very important crop for millions of smallholder farmers spread across various regions in Indonesia. There are many factors that constrain rice production, one of which is the decline in rice productivity due to pest attacks. OPT attacks reduce global crop production by up to 40%, causing losses to farmers. If this continues, it will have an unfavourable impact on the country's economy and food security, therefore efforts are needed to anticipate it by promoting technology that is more efficient, economical, and environmentally friendly. One of the efforts to increase production can be done through an integrated pest control system (IPM) [1]

IPM is a pest population control strategy that takes into account ecological factors. Integrated pest control efforts must consider several aspects including safety, health, and the environment throughout production, so the use of chemical pesticides in this system is the last resort after other control methods cannot minimise pest populations that have exceeded economic limits. The use of integrated pest control methods is a good choice because it can provide several advantages such as maintaining pest populations or levels of pests. pest infestation remains below the economic threshold, increases production yields and the quality of agricultural products. increases income, is safe for health and the environment, and in the long term can preserve and improve environmental quality [2]

In an effort to increase rice production and control the decline in production due to pest attacks, the government held

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an SL-PHT programme. This programme is one way of extension that involves the active role of farmers, so that not only does the knowledge of farmers increase but their skills are also improved through direct practice in the field. Tegineneng sub-district is one of the areas selected to implement the SL-PHT programme. The programme was implemented in Rejo Agung village, precisely in the rukun jaya farmer women group (KWT). This KWT is the only KWT in Tegineneng Sub-district selected to implement the programme, KWT rukun jaya was chosen because it is considered active and capable in implementing the programme. The programme is expected to increase knowledge. The programme is expected to increase farmers' knowledge and skills so that farmers are aware, willing, and able to apply integrated pest management to reduce yield reduction due to pest attacks and increase rice production. The purpose of this study was to determine the level of adoption of farmers in IPM of wetland rice plants in Tegineneng Subdistrict, Pesawaran Regency.

II. RESERCH METHODS

This research was conducted in Rejo Agung Village, Tegineneng Sub-District, Pesawaran Regency, Lampung Province. Rejo Agung village was *purposively* selected as the research location by considering that the village was one of the places where SL-PHT was implemented. SL-PHT.The research was conducted from June to July 2023. The sample size was determined using the census method, which involved the entire population of farmers participating in the SL-PHT programme. Information gathering was conducted using question forms that had previously been tested for validity and reliability. The analytical method applied is descriptive quantitative by going through 2 stages, namely:

a. Presentation of Y variable data and farmer adopter level using tabulation

b. Determination of the tendency of the value of each variable using class intervals with the following formula:

$$Class\ Interval = \frac{Highest\ Value - Lowest\ Value}{Classification}$$

III. RESULTS AND DISCUSSION

3.1. Farmer Characteristics

Age

Age is the length of a farmer's life from birth until this study was conducted. Farmers who are at a productive age tend to be open to new ideas and methods to improve the results of their farming business. The distribution of respondents by age can be seen in Table

Table 1. Age

Age	Classification	Number (people)	%
30-43	Young	7	35,00
44-57	Middle-aged	5	25,00
58-72	Old	8	40,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 1, it is known that the age range of respondents is 30-72 years and most farmers fall into the productive age category (15-64). Farmers of productive age generally have the ability to think, work, and run their farming business. The age of farmers also affects the capacity or learning ability of farmers, the older the age of farmers, the lower the learning capacity of farmers. [3] revealed that age plays an important role in obtaining economic success because age will affect memory, productivity, willingness to take opportunities, and attitudes of farmers to adopt innovations in agriculture.

Length of Farming Business

The length of farming business is the time that farmers have used in undergoing business in agriculture, namely rice. The length of farming business is classified into three groups, namely new <10 years, long enough 10-20 years and long 20 years

[4]. The distribution of respondents according to the length of farming business can be seen in Table 2.

Table 2. Length of Farming Business

Length of business Farmer	Classification	Number (people)	%
<10	Baru	6	30,00
10-20	Cukup lama	7	35,00
>20	Lama	7	35,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 2, it is known that the length of the respondent's farming business is mostly in the range of 10-20 years, namely a total of 7 people with a percentage of 35 percent, and the length of farming business> 20 years, namely a total of 7 people with a percentage of 35 percent. The longer a person works, the more expertise and skills they will have because of their experience. This experience can be used as a benchmark by farmers in making decisions, in order to deal with the problems faced by farmers in running their farming business [5]

Formal Education Level

Formal education level is the final level of education undertaken by farmers until the research was conducted. Formal education is structured, systematic, level-based (tiered) and follows explicit criteria. The level of formal education is divided into three, namely basic education, secondary education, and higher education (Law No. 20/2003). The distribution of respondents by formal education level can be seen in Table 3.

Table 3. Formal Education Level

ducation Level	Total (person)	(%)
Basic education	17	85,00
Secondary education	3	15,00
Higher education	0	0,00
Total	**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 3, it is known that most of the respondents' formal education level is in primary education, namely 17 people with a percentage of 85 percent. A high level of education serves as an indicator that describes an individual's capacity to do work or assume certain responsibilities. The level of education also affects a person's ability to absorb new information or technology.

Land Area

Land area refers to the area of paddy fields managed by farmers in carrying out rice farming activities. In this study, the measurement of land area was carried out using units of square meters (m^2). The distribution of respondents according to land area can be seen in Table 4.

Table 4. Land Area

Land Area	Classification	Number (people)	%
800-2100	Narrow	10	50,00
2200-3500	Medium	7	35,00
3600-5000	Extensive	3	15,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 4, it is known that 10 people with a percentage of 50 percent of respondents have a land area with a size of 800-2100 m^2 . Farmers with larger land areas will find it easier to apply extension advice and accept new technology than those with narrow land [6].

Land ownership status

Land ownership status is an important consideration for farmers in running a farming business. Land ownership status is classified into three: self-owned, rented, and shared land. The distribution of respondents based on land ownership status can be seen in Table 5.

Table 5. Land Ownership Status

Classification	Total (person)	%
Owned	18	90,00
Profit sharing	1	5,00
Rent	1	5,00
Total	**50**	**100,00**

Source: Primary Data Processed 2023

Based on Table 5, it is known that most respondents' land ownership status is self-owned land as many as 18 people with a percentage of 90 percent. Ownership of land as an owner provides benefits, comfort, and security for farmers because it reduces the capital costs that will be incurred[7].

Cosmopolitan Level

The cosmopolitan level indicates the tendency of farmers to be open to situations outside their social structure. The cosmopolitan level is characterized by an expansive view of and interaction with the outside world, as well as high mobility among various social groups. The distribution of respondents by cosmopolitan level can be seen in Table 6.

Table 6. Cosmopolitan Level

Cosmopolitan Level	Classification	Number (people)	(%)
6-9	Low	1	5,00
10-13	Medium	18	90,00
14-18	High	1	5,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 6, it is known that the majority of respondents' cosmopolitan level is in the score range of 10-13, as many as 18 people with a percentage of 90 percent. Farmers with a high cosmopolitan level are faster in making decisions about adopting innovations in their farming businesses, even though they do not know the exact advantages of these innovations [8].

Extension Intensity

Extension intensity is the level of

The presence or frequency of farmers in following the extension activities carried out. The intensity of counseling in this study was calculated from the frequency (times) of farmers in following SL-PHT. The distribution of respondents according to the intensity of counseling can be seen in Table 7.

Table 7: Extension intensity

Intensity Extension	Classification	Total (person)	%
5-6	Low	4	20,00
7-9	Medium	7	35,00
10-12	High	9	45,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 7, it is known that the majority of respondents' counseling intensity is at a frequency of 10-12 times, as many as 9 people with a percentage of 45 percent. The success of technology adoption is highly calculated through agricultural extension activities. The level of adoption of farmers increases directly proportional to the frequency of their involvement in extension activities. The higher the frequency of farmer participation in extension activities, the greater the growth of the adoption rate [9].

Institutional support

Institutional support is support provided to farmers in the form of rules, values, or policies that help farmers and come from agricultural institutions, including extension support, government support, and farmer group support. The distribution of respondents based on institutional support can be seen in Table 8.

Table 8. Institutional Support

Support Institutional	Classification	Number (people)	%
14-22	Low	0	0,00
23-32	Medium	18	90,00
33-42	High	2	10,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 8, it is known that the majority of respondents' institutional support is in the range of 23-32, namely as many as 18 people with a percentage of 90 percent. High institutional support helps farmers in adopting a technology, this is because of the assistance felt by farmers so that farmers feel easy in adopting technology.

3.2. Farmer Adoption of IPM (Y)

Healthy Plant Cultivation

One of the principles of IPM is healthy crop cultivation, this principle is achieved through the integration of all cultivation methods with a focus on minimizing negative impacts on the environment. Healthy crop cultivation is a strategy

that prioritizes elements of plant protection in crop cultivation techniques. Smith in Mudjiono, [10] The elements of plant protection in the principles of healthy crop cultivation in this study are seen from the use of quality seed varieties. the implementation of the seedbed stage, setting plant spacing , irrigation, fertilization, the use of chemical pesticides , and the number of seeds used per planting hole. The level of farmer adoption of healthy crop cultivation principles was classified as follows into three: low, medium and high. The distribution of respondents according to the level of farmers' adoption of healthy crop cultivation principles can be seen in Table 9.

Tabel 9. Healthy Plant Cultivation

Score	Classification	Number (people)	%
7-11	Low	2	10,00
12-16	Medium	11	55,00
17-21	High	7	35,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 9, it is known that the level of adoption based on the principles of healthy plant cultivation, most respondents are in the range of scores 12-16, namely a total of 11 people with a percentage of 5 5 percent. This shows that the cultivation of healthy plants by farmers is included in the medium classification. In the element of using superior seed varieties, farmers use hybrid and inbred seed varieties such as inpari 32, ciherang and there are some farmers who use the first derivative seeds from the cultivation of rice plants in the previous planting season . Farmers who use derived seeds reason that this is done because they see the previous harvest is good, so it is used as a seed with the hope that the next harvest will also be as good, as well as to save capital costs. In the element of implementation of the seedbed stage, farmers carry out seedbeds starting from tillage, use of fertilizers, making nursery beds, soaking seeds, sowing seeds, seed treatment until the seeds are ready for planting. This is because farmers consider seedbeds to be an important stage in the cultivation process, as good seedbeds will produce healthy, strong and disease-free seeds.

At the stage of setting the planting distance, all farmers have used the planting distance in the rice farming business they run, the difference is the size of the planting distance. Most farmers use a planting distance between 23cm x 23cm, 25cm x 25cm, 24cm x 24cm and jajar legowo. In the element of irrigation implementation most farmers do not carry out irrigation effectively and efficiently, this is because there is no irrigation in their rice fields so that farmers only rely on rainfed only. Only a few farmers carry out irrigation by utilizing river water using a water suction machine, this is because farmers have to pay additional costs if they want to rent a water suction machine, so it is done when the farmers' fields are really dry.

In the element of fertilization implementation, most farmers carry out fertilization 2 times in one growing season and some others 3 times in one growing season. This is adjusted to the nutrient needs of plants and also the capital owned by farmers, because the more fertilization is done, the greater the capital that will be spent. Some farmers conduct basic fertilization at the time of tillage or before planting using manure by utilizing livestock manure waste that they have. Supplementary fertilization is carried out by farmers using compound fertilizers such as NPK, urea, phonska, or TSP 36. Supplementary fertilization is usually given when the plants are 7-14 hst, the second supplementary fertilization is 21-28 hst, and farmers who carry out the third supplementary fertilization are usually at the age of 35-42 hst.

On Element of the use of chemical pesticides farmers still use chemical pesticides in the rice farming business they run, the use of chemical pesticides is not in full but coupled with the use of vegetable pesticides. According to farmers, this is because the use of vegetable pesticides provides a longer effect in eradicating pests than chemical pesticides, so it is feared that the population of pest attacks is expanding while the effect of vegetable pesticides has not been seen. In the element of the number of seeds used per planting hole, most farmers use 3 to 5 rice seeds per planting hole. According to farmers, the determination of the number of seeds used is adjusted to the size and quality of the seeds, if the size and quality of the seeds are good then use 3 seeds, while if the quality of the seeds is not good and the size of the seeds tends to be small then use 4 to 5 seeds. In this principle, farmers are already at the *adoption* stage, this can be seen from the attitude of farmers who have practiced the elements of healthy crop cultivation although not optimally due to several obstacles.

Utilization of Natural Enemies

Utilization of natural enemies is a pest control technique using natural enemies, namely parasites, predators, and organisms that cause disease in plants. The concept of using natural enemies as a form of pest control has been around for a long time, but has been displaced due to the rapid development of chemical pesticide industry technology. The utilization of natural enemies to eradicate pest populations is good to apply because it is environmentally friendly and safe for human health. [11] The elements of natural enemy utilization used in this study were seen from natural enemy utilization and the number of natural enemies used , and in addition, the type of natural enemies used. The level of adoption of farmers on the principle of utilization of natural enemies is classified into three namely low, medium and high. The distribution of respondents according to the level of adoption of farmers in the principle of natural enemy utilization can be seen in Table 10.

Tabel 10. Utilization of Natural Enemies

Score	Classification	Total (person)	%
1-2	Low	15	75,00
3-4	Medium	4	20,00
5-6	High	1	5,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 10, it is known that the level of adoption based on the principle of utilization of natural enemies, the majority of respondents are in the 1-2 score range, namely a total of 15 people with a percentage of 75 percent. This shows that the utilization of natural enemies by farmers is included in the low classification. In the element of using natural enemies, most farmers have not utilized natural enemies as plant pest control. This is because farmers consider that the use of natural enemies is difficult to do because it involves live animals and requires extra care, besides that the results of control also cannot be immediately seen in a short time but requires a relatively long period of time. According to one farmer, he once used owls and made a rubuha (owl house) on his land, but the owls flew away and did not return, so the rubuha is empty until now and makes farmers reluctant to use owls again.

In the element of the number of natural enemies used, farmers who utilize natural enemies only use 1-2 types of natural enemies. The types of natural enemies used are snakes, spiders, owls, and cats. Utilization of snakes and spiders is done when the natural enemies are in the farm, so farmers do not deliberately bring the natural enemies to the land. In the case of cats and owls, farmers intentionally bring these natural enemies to eradicate existing pests such as field mice. In the principle of utilizing natural enemies, the majority of farmers are at the *evaluation* stage and have not adopted the use of natural enemies, this can be seen from the opinions and attitudes of farmers regarding the use of natural enemies. Farmers consider that the utilization of natural enemies is difficult to do and requires extra care.

Routine Observation

Routine observations are carried out as an effort to determine the density and type of pests, the severity of pest attacks, the area of spread of pests, factors that affect the development of pests, and the severity of damage due to natural disasters. The results of routine observations can help farmers decide when and how control should be carried out [12.]The elements of routine observation used in this study are seen from observation routines and activities carried out in routine observations . The distribution of respondents based on the level of adoption of farmers in the principle of routine observation can be seen in Table 11.

Table 11. Routine Observations

Score	Classification	Total (person)	%
1-2	Low	0	0,00
3-4	Medium	4	20,00
5-6	High	16	80,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 11, it is known that the level of adoption based on the principle of routine observation of respondents is mostly in the score range of 5-6, namely a total of 16 people with a percentage of 80 percent. This shows that routine observations made by farmers are included in the high classification. In the routine element of routine observation most farmers conduct routine observations more than once a week or about three to four times a week, as an effort to prevent the spread of pests. In the opinion of farmers, the more often they conduct routine observation activities, the more they can minimize pest attacks. This is because farmers can find out early the symptoms of pest attacks, so they can take control measures as early as possible so as to minimize the decline In production due to widespread pest attacks.

In the element of activities in routine observation, the observation activities carried out by farmers are observing the symptoms of pest attacks by going directly to the fields, according to farmers this needs to be done because if observing from the edge of the rice fields, the symptoms and population of pest attacks cannot be seen clearly. Generally, if there are pests that attack and the density of attack is in a very low category, then farmers will carry out mechanical control only, such as snails will be taken and used as food for livestock such as ducks and ducks. If the density of pest attack tends to be moderate or high, then farmers will control using vegetable or chemical pesticides. According to most farmers, the results of these routine observations are the basis for consideration for farmers in making decisions on farming operations such as weeding, replanting, breeding, irrigation, fertilization, and other cultivation activities. In this principle, farmers are already at the *adoption* stage, which can be seen from the attitude of farmers who already believe in the advantages of adopting routine observations. Farmers have conducted intensive observations because they believe that routine observations are beneficial in minimizing the spread of pest attacks.

Farmers as IPM Experts

Farmers are individuals who are responsible for supervising, managing and making decisions on their own fields. Farmers must be confident, have independence, and have the ability to use IPM principles on their land. Farmers must be able to act as observers, analyzers, decision makers, and implementers of IPM. This ability can be owned by farmers through the Integrated Pest Management Field School (SL-PHT) and additional experience gained from the application of IPM in the field. [13]. The elements of farmers as IPM experts used in this study are seen from the use of vegetable pesticides, the ability to make vegetable pesticides, knowledge about the application and dosage of the use of vegetable pesticides . The distribution of respondents according to the level of adoption of farmers in the principle of farmers as IPM experts can be seen in Table 12.

Table 12: Farmers as IPM Experts

Score	Classification	Number (people)	%
4-6	Low	0	0,00
7-9	Medium	13	65,00
10-12	High	7	35,00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 12, it is known that the level of adoption based on the principle of farmers as IPM experts, most respondents are in the score range of 7-9, namely a total of 13 people with a percentage of 65 percent. This indicates that the adoption of farmers as IPM experts is included in the medium classification. In the element of using vegetable pesticides farmers have used vegetable pesticides. Generally, if the density of pest attacks is wide, farmers will use chemical pesticides, on the other hand, if the density of pest attacks is relatively small, farmers will use vegetable pesticides. According to farmers, this is because the use of chemical pesticides has a faster impact than the use of vegetable pesticides, therefore, if the symptoms of pest attack are widespread, farmers use chemical pesticides to accelerate the eradication of pests so that they do not become more widespread. In addition, farmers also do not know some types of vegetable pesticides that are suitable for pests such as rats and snails.

In the element of the ability of farmers in making vegetable pesticides most farmers are quite capable in making vegetable pesticides, the ability of farmers comes from the experience they have and also from the activities carried out by farmers during SL-PHT. Generally farmers use natural ingredients such as soursop leaves (for leafhoppers and locusts), tobacco (for walang sangit, caterpillars, aphids), mengkudu (for snails), lamtoro and garlic (for sundep and caterpillars) as the basic ingredients for making vegetable pesticides. In the element of farmer knowledge in the application of vegetable pesticides, farmers are quite familiar with the application of vegetable pesticides, the application is done by mixing vegetable pesticides with water and then sprayed using a *hand sprayer* to the part of the plant that is attacked by pests. In the element of farmer knowledge about the dose of the use of vegetable pesticides, farmers are quite aware of the dose used in the use of vegetable pesticides. According to the information of farmers, the dose recommended by the extension agent in the use of vegetable pesticides based on the SL-PHT that was followed was ± 250 ml for 1 10-liter water tank.

In this principle, farmers are already at the *adoption* stage, this can be seen from the attitude of farmers who have implemented the use of vegetable pesticides. Farmers are already quite skilled in making their own vegetable pesticides, generally each farmer makes vegetable pesticides independently and is implemented into their respective fields. The farmer's expertise is obtained from the extension activities followed by farmers. The results of this analysis are in line with the analysis of [14] which says that the level of adoption of farmers as IPM experts is in the medium category. Farmers' expertise in IPM affects pest control decisions made by farmers in running their farming businesses, therefore farmers' expertise is important to be improved.

Total Score of Farmers' Adoption of IPM

Farmers' adoption of IPM is determined by the cumulative score of four IPM principles, namely healthy plant cultivation, utilization of natural enemies, routine observations, and farmers as IPM experts [15]. The distribution of respondents based on the total score of the adoption level can be seen in Table 13.

Tabel 13. Total Score of Farmers' Adoption of IPM

Score	Classification	Total (person)	%
25-31	Low	9	45.00
32-38	Medium	11	55.00
39-45	High	0	0.00
Total		**20**	**100,00**

Source: Primary Data Processed 2023

Based on Table 13, it is known that the level of adoption in IPM respondents mostly in the range of scores 32-38, namely a total of 11 people with a percentage of 55 percent. This shows that farmers in adopting IPM in total are included in the medium classification, in other words, integrated pest control has not been fully adopted by farmers, so it needs to be improved on each principle. In the principle of healthy crop cultivation, the element of irrigation needs to be improved and the use of chemical pesticides needs to be reduced. Effective and efficient irrigation can help plant growth and development so as to increase production. The use of chemical pesticides needs to be reduced because the continuous use of chemical pesticides

can be harmful to safety, health and also the environment.

In the principle of utilizing natural enemies, the use of natural enemies and the number of natural enemies need to be increased, because they can help in pest control so as to minimize the use of excessive chemical pesticides. In the principle of farmers as IPM experts, the element of using vegetable pesticides and the ability of farmers to make vegetable pesticides needs to be improved. The use of vegetable pesticides needs to be increased because it provides many advantages, namely it can control pests, produce production that is safer for safety, health and also the environment. The ability or skills of farmers in making vegetable pesticides can be improved through non-formal education, namely extension activities and also the cosmopolitan level. This is in line with the analysis of [16] which shows that the level of adoption of farmers after attending SL-PHT is in the medium category so it needs to be improved.

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