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Study on Factors Influencing the Utilization Level of Combine Harvester by Farmers

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ABSTRACT

The aim of this research is to determine the level of use of combine harvesters and the factors that influence it. The research location was chosen deliberately, namely in Negeri Katon District which received assistance from 3 combine harvester units. The respondents in this study were 53 farmers from 3 farmer groups who received combine harvester assistance. The data collected was analyzed using descriptive analysis and the Kendall tau statistical test. The results of the research show that the level of use of combine harvesters on the indicators of plant condition requirements shows a good category, where farmers harvest rice when it reaches the optimum age. The indicator for plant condition requirements shows a fairly good category, where farmers harvest when the land is dry, but farmers never confirm whether the land conditions are dangerous and can damage machinery. The machine application indicator shows the poor category, where the intensity of farmers using combine harvester machines is 3 - 4 times in 5 harvest seasons, and farmers are still less skilled in operating combine harvesters. Factors related to the use of combine harvesters by farmers are land area, relative profit, compatibility, complexity, trialability, observability, and the role of farm extension workers.

1. INTRODUCTION

Food crops have a key role in maintaining national economic stability, so that this subsector has consistently become the government's main focus of attention (Prasetia *et al*., 2015). Farmers in Indonesia cultivate various food crops, including rice (*Oryza sativa*), which plays a very important role as the main food source. With population growth continuing to increase, rice availability has become a critical factor in meeting people's food needs. Therefore, increasing rice production is a necessity to answer these demands. Farmers have a central role in efforts to increase rice production. Despite this, they face challenges in the harvesting process, which is an integral part of rice cultivation. This process includes a series of activities, starting from cutting the stalks of mature rice to releasing the grains from the panicles (Anisa *et al*., 2018). Farmers can adopt modern agricultural technology as a step to increase rice production. One innovation that can reduce crop losses and significantly increase efficiency is the use of combine harvesters.

Combine harvester is a machine that has complex functions including cutting rice, threshing and cleaning rice grains simultaneously while moving in the field. Combining these functions provides higher efficiency in terms of time and energy for harvesting activities, without requiring as much labor as traditional manual harvesting methods. Another advantage of a combine harvester is its ability to reduce harvesting and threshing costs, reduce labor involvement, speed up land preparation for the next planting, and speed up the marketing process for harvested crops or rice grain (Zakky *et al*., 2021). The application of a Combine harvester in rice farming can reduce yield losses by around 200.39 kg per hectare, or the equivalent of around 3.52 percent (Amrullah & Pullaila, 2020).

Combine harvesters and other agricultural machinery are machines that have prices beyond the reach of farmers in general. The government, through the Ministry of Agriculture, has made a breakthrough in increasing the Planting Index (IP) and productivity of rice plantations in food crop production centers. This program is supported by the provision of agricultural tools and machinery. This government assistance with machine tools began during the era of President Susilo Bambang Yudoyono in 2012. The total farm machineries distributed in period of 2012-2014 were 34,530 units. In the era of President Jokowi, the agricultural machinery assistance program was further strengthened and become the largest agricultural machinery assistance in the history of agricultural development in Indonesia (Hermanto *et al*., 2018). In 2015, for example, 345,546 units of agricultural machineries were distributed. This figure doubled to 771,904 units in 2016 and in 2017 it reached 284,041 units (Sulaiman *et al*., 2018).

From 2015 to 2021, the Ministry of Agriculture has distributed 511,348 units of pre-harvest machinery, consisting of 2-wheeled tractors, 4-wheeled tractors, cultivators, water pumps, rice transplanters, and hand sprayers. Meanwhile, there are no less than 41,816 post-harvest machinery units, in the form of small, medium and large combine harvesters (for rice and corn), dryers, power threshers, multi-purpose power threshers, com shellers and rice milling units. This machineries assistance has been distributed to Poktan (Farmer Group), Gapoktan (Farmer Group Association), UPJA (Management Unit of Farm Machinery Services) in form of farm machinery brigades within production center areas to achieve sustainable food self-sufficiency towards realizing food sovereignty (Kementerian Pertanian, 2022a). Now, the government is still budgeting for agricultural machinery grant, especially pre-harvest machines, namely hand tractors, 4-wheeled tractors, water pumps, hand sprayers, cultivators, and excavators (Kementerian Pertanian, 2022b; 2023).

Initial survey results in the field show that combine harvester assistance has begun to be used. However, not all farmers immediately use this technology. However, not all farmers immediately use this technology. Some farmers are still waiting and need time to implement combine harvester machines in their farming activities. Some farmers feel that this machine is less profitable and less suitable for the conditions of the farmer's land. Farmers in farmer groups who receive combine harvester assistance do not always use this machine in the harvesting process and still harvest using conventional methods. This is due to various factors that influence the use of this technology, both factors that exist within the farmer (internal) and factors that come from outside the farmer. Based on the description above, this research was conducted to analyze the level of use of combine harvester machines by farmers, and what factors are related to the use of combine harvesters by farmers. It is hoped that the research results can be used as material in managing government-assisted combine harvesters by farmer groups so that this vital machine can function optimally with maximum service life.

2. MATERIALS AND METHODS

This research was carried out in Tresno Maju Village, Negeri Katon District, Pesawaran Regency (Figure 1). The research location was chosen purposively with the consideration that the location had received 3 units of combine harvester from the government and implemented them in the farming activities. The combine harvester consisted of 2 units of medium size and 1 unit of small size. The machine was provided to 3 farmer groups (FG), namely Ngudi Makmur FG, Maju Sejahterahkan Petani FG, and Mekar Sari 1 FG. Initial survey in the field showed that combine harvester begin to be used in 2021, but not all farmers immediately use this technology.

Simple random sampling was used to select 53 farmers as respondents out of. They were members of FGs spread across three FGs out of the total number of group members (113 farmers) receiving combine harvester provision. The data collection method used in this research was through interviews and literature study. The level of use of the combine harvester was tested using quantitative descriptive analysis, indicators of the level of use of the combine harvester were measured based on three components, namely plant condition requirements, land condition requirements, and machine application. Three indicators were used to measuring the utilization level of combine harvester machine including:

Crop condition requirements. According to the BPP Mektan (2016), harvesting rice plants using a combine harvester machine should be done when the rice reaches the optimum age, where the maturity level of the rice plants has reached 80-90 percent, and was indicated by the yellow color of the rice plants or the panicles are dry, plant height maximum of 120 cm. It is recommended to harvest during the day when the plants are dry. Issues regarding the timeliness of harvest were classified into three categories, namely good, fair and poor.

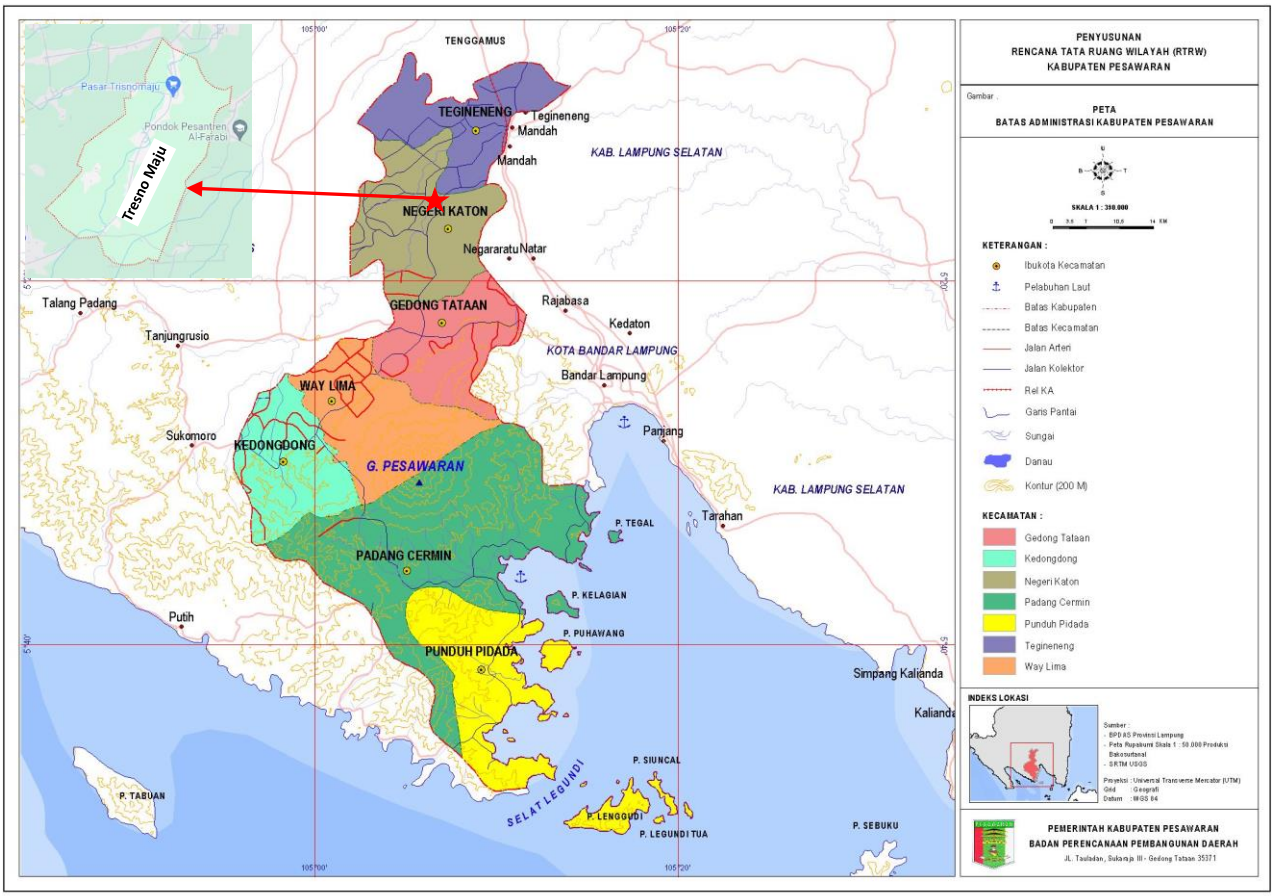

Figure 1. Map of Pesawaran Rgency. (Research location: Trisno Maju Village in Negeri Katon Subdistrict is red stared and inzet)

Land Condition Requirements. When using the combine harvester machine, it is recommended that the land be dry with a maximum mud depth of 30 cm and ensure that the land is clean of stones, logs and bamboo to make it easier for the machine to operate on the land (Agricultural Mechanization Research and Development Agency, 2016). Issues regarding land preparation were classified into three categories, namely good, fair and poor.

Application of the combine harvester machine. The application of the combine harvester machine is measured based on the farmer's intensity in using the combine harvester machine in the harvesting process and the farmer's ability to operate the combine harvester machine is classified into three categories, namely high, medium and low.

Class interval (CI) of combine utilization level was formulated according to the equation (1). The interpretation of the interval score referred to the following: CI score of 2.00 – 3.33 is low or poor category; CI score of 3.34 – 4.67 is relatively good category; and CI score of 4.67 – 6.00 is good category.

$$\text{CI} = \frac{(highest\ score - lowest\ score)}{\sum class} \quad (1)$$

There were 10 factors that are hypothesized to have influences on the level of combine harvester utilization, as described briefly as the following. Each factor was categorized into 3 levels.

1. Age (X1): is the age of the FG members at the time of research, expressed in year. Age was categorized into three levels: young (not yet productive) (<16 year), productive (16-64 year), and old (unproductive) (>64 year).
2. Formal education (X2): is level of knowledge and skills obtained by members of FG gaining from school or other formal educational institutions and is categorized into 3 levels: low (basic school), middle (high school), and high (college and university).

3. Land size (X3): is the land area (ha) managed by members of FG for cultivating rice, classified into three categories: small (<0.5 ha), slightly big (0.5 – 1.0 ha), big (>1.0 ha).
4. Experiences (X4): is the length of farming activity of FG members in carrying out rice cultivation (in year), and is categorized into three levels: new (15 – 26 year), medium (26 – 36 year), and experienced (36 – 48 year).
5. Relative advantage (X5): is the degree to which a combine harvester is perceived as better than the previous practices or technologies. This is calculated based on a score and categorized into 3: not profitable (score 4-6), slightly profitable (score 7-9), and profitable (score 10-12).
6. Suitability (X6): is a when a perception of FG members about combine harvester in accordance with existing values, past experience, and the needs of potential people as adopters. This is calculated based on scores and categorized into 3: not suitable (score 4-6), slightly suitable (score 7-9), and ompatible or suitable (score 10-12).
7. Complexity (X7): is a when a perception of FG members about combine harvester as easy to understand or use. This is calculated based on scores and categorized into 3: complicated (score 4-6), relatively easy (score 7-9), and easy (score 10-12).
8. Trialability (X8): is the degree to which a combine harvester is easy to be tested or operated by farmers which is calculated based on scores and categorized into 3 categories: difficult (score 4-6), relatively easy (score 7-9), and easy (score 10-12).
9. Observability (X9): is the degree to which the results of a combine harvester application can be seen by other people or adopters which is calculated based on scores and categorized into 3 categories: difficult (score 4-6), relatively easy (score 7-9), and easy (score 10-12).
10. Role of extension workers (X10): is the role of the extension workers to influence farmers in using the combine harvester machine which is calculated based on scores and categorized into 3 categories: less significant (score 10-16), slightly significant (score 17-23), and significant (score 24-30).

Factors related to farmer utilization of the combine harvester were tested using the Kendall tau (τ) statistical test, as follows (Anwar, 2009):

$$\tau = \frac{(\sum A - \sum B)}{N(N-1)/2} \quad (2)$$

where τ is the Kendall tau correlation coefficient, A is the number of top ranks, B is the number of lower ranks, and N is the number of sample members. The decision making rules for Kendall tau correlation (2 tailed) are as follows: if the significance value (2 tailed) > α (0.10), then there is no relationship with the variables being tested, and if the significance value (2 tailed) < α (0.10), then there is a relationship with the variables being tested.

3. RESULTS AND DISCUSSION

3.1. Respondent Characteristics

Farmers as the main actors in farming have various characteristics that reflect the motivation, personal characteristics, self-concept, values, knowledge and skills possessed by successful farmers in agricultural businesses (Hapsari *et al*., 2019). The characteristics of respondents observed in this study were age, education level, land area, and experiences. The age of respondents in this study was in the productive category, namely 16-64 years. Age can influence farming activities and the adoption of agricultural technology by farmers. Age is also related to farming experience which is an important factor for farmers in efforts to increase their productivity and work ability. The experience that farmers have can be obtained from previous farmers or passed down from generation to generation or from their own experience. The longer a farmer's farming experience, the more skilled and intelligent the farmer will be in farming and in solving the problems they face (Manyamsari & Mujiburrahmad, 2014). The average length of experiences that respondents have been in rice farming was in the medium category, namely 26-36 years. The level of formal education received by farmers will encourage changes in thinking and behavior towards all things. Education is an important factor in acquiring knowledge. The higher a farmer goes, the higher their level of knowledge (Prastisi *et al*., 2023). The average level of

formal education of respondents as low, namely elementary school. The size land area affects the farmer's income (Pradnyawati & Cipta, 2021) and can be an important factor in the application of agricultural machinery (Yohanna *et al*., 2011). The average land area of respondents was classified as slightly big category with area of 0.5-1.00 ha.

3.2. Utilization Level of Combine Harvester

Table 1 shows the utilization level of combine harvester machines in Negeri Katon District. In this study the utilization level was evaluated based on 3 components, namely: plant condition requirements, land condition requirements, and combine harvester application.

Table 1. Components for the level of use of the combine harvester machine

No	Variable	Average score	Category
1.	Crop condition requirements	5.75	Good
2.	Land condition requirements	4.01	Fairly good
3.	Machine application	3.24	Not good (low)

3.2.1. Plant Requirements

The results show that based on plant condition requirements component, the level of combine harvester utilization is classified as good category with a score of 5.75. The assessment for the plant requirements was conducted based on rice harvesting condition that was carried out at the optimum age and harvesting was executed during the day when the plants are dry. Harvesting at the optimum age is characterized by the grain is 90-95% yellow or golden, at about 30-35 days after flowering or 135 to 145 days after planting (Fahroji & Zulfia, 2014). Based on the conditions in the field, rice harvesting using combine harvester machine was always carried out at the optimum age and farmers have no difficulty in finding harvest workers, especially during the peak harvest.

Harvesting rice at the optimum age is very important to obtain good quality rice and reduce yield losses. Molenaar (2020) reported that when rice is harvested before it reaches optimum maturity, the quality of the rice will be poor because the rice calcifies (rice breaks easily) and the color of the rice becomes dull. On the other hand, farmers who harvest after the rice plants have passed optimum maturity can increase the loss of grain because some of the grain has already fallen off before it is harvested. Farmers who use combine harvester machines who harvest at a plant age that is not optimal can have difficulty getting a machine, because the machine is damaged and has to wait for repairs.

Harvesting time also needs to be paid attention to by farmers using combine harvester machines. The recommended harvest time is during the day starting at 08.30 in dry crop conditions with grain moisture content ranging from 20-22%. Rice that is harvested too wet can affect the grain shedding process. Rice harvesting is carried out during the day with the aim of reducing the humidity level in the plants. Rice that has a high water content can inhibit the process of threshing rice seeds and limit visibility in rice fields, thereby ensuring higher efficiency in the harvest process.

3.2.2. Land Requirements

From the aspect land condition requirements, results reveals that the utilization of combine harvester can be classified as slightly good category with average score of 4.01. According to Durroh (2020), the performance of the combine harvester is greatly influenced by land conditions during the harvest process. Harvesting on waterlogged land has a significant impact on the movement and speed of equipment, because the muddy conditions in the soil can cause equipment movement to be relatively slow. Based on conditions in the field, harvesting by farmers using combine harvesters was done mostly during the day when the soil are relatively dry. Farmers already understand that harvesting using combine have to be carried out during the day and dry crop conditions with the aim of reducing the water content of the rice, and wider visibility in the rice fields. Farmers who sometimes do harvesting at night due to the limited number of combine harvesters faced problems with limited visibility and decrease in rice yield.

The majority of farmers who use combine harvester machines always ensure that the land is dry with mud depth < 30 cm so that the machine can operate efficiently and avoid the risk of the machine getting stuck in the land. Mud depth of 30-50 cm at harvest can be found on farmers' land in swampy land with a clay texture. This condition will slow down

the movement of the combine harvester machine so that it takes longer compared to dry land conditions. According to Hasanah (2022), muddy ground conditions have a serious impact on the efficiency of movement of combine harvester machines. When the tool moves in muddy land with a depth of more than 30 cm, the speed and movement of the tool becomes limited, and the machine cannot operate optimally. When faced with muddy land, fuel consumption during the harvesting process also increases. In general, the need for diesel fuel for the rice harvesting process is estimated to be around 15 L/ha. In deep muddy conditions, the amount of fuel required can exceed this estimate, thereby increasing overall operational costs.

Included in the land condition requirements is ensuring that the land is clear of obstacles to the combine harvester machine such as fallen logs, rocks and other hard objects that could interfere with operation and cause machine damage. Based on observations in the field, farmers never check the land for obstacles before using the combine harvester machine. Farmers believe that their land is clean, so they never inspect the land for obstructions.

3.2.2. Machine Application Rate

From the aspect of machine application rate, the utilization of combine harvester in the research location was classified as poor category with average score of 3.24. The application rate of combine harvester was assessed based on the farmer's intensity of using the machine, starting from the first time they receive the machine until the time the research. Based on our survey, the intensity of farmers in using combine harvester is 3-4 times out of 5 harvesting seasons. At the beginning, farmers were reluctant in using the combine harvester machine and did not immediately use the machine in the harvesting process, the farmers harvested the rice using conventional methods, and labor was not difficult to find. Farmers became interested in using it after seeing the success of other farmers and when harvesting workers became increasingly difficult to find.

The machine application rate component was also assessed from the farmer's ability to operate the combine harvester, from starting the engine, operating, and stopping the machine. Based on field survey, 94.34% of farmers were unable to operate the machine because of lack in training regarding how to operate combine harvester machines. The role of agricultural extension workers as farmer educators is more focused on conveying courses regarding good plant cultivation procedures and as an intermediary between farmers and the government in obtaining production facilities, especially combine harvester machines. Some farmers classified as fairly good category in the aspect of application rate were representatives of FG members who took part in operation training for combine harvester machine held by the District Agricultural Office (Dinas Pertanian) of the Pesawaran Regency. These farmers, however, only know few aspects of operating the machine, such as how to turn the machine on and off. Farmer group representatives who took part in the training still had difficulty to operate the machine because they were still unconfident of operating the machine, therefore the combine harvesters provided by the government were operated by operators outside the FG who had experience in operating combine harvesters.

Table 2. Results of analysis of factors related to the level of use of combine harvester technology

No	X Variable	Y Variable	Correlation Coefficient	Sig.(2-tailed)
1	Farmer age (X1)	Utilization level of combine harvester (Y)	0.031	0.776
2	Formal education level (X2)		0.114	0.247
3	Land size (X3)		0.506***	0.000
4	Farming experiences (X4)		0.080	0.456
5	Relative profit (X5)		0.650***	0.000
6	Compatibility (X6)		0.312***	0.006
7	Complexity (X7)		0.582***	0.000
8	Trialability (X8)		0.252**	0.025
9	Observability (X9)		0.235**	0.041
10	Role of farm extension workers (X10)		0.191*	0.080

Note: * = Correlation is fairly significant at significance level of 90%
** = Correlation is significant at significance level of 95%
*** = Correlation is highly significant at significance level of 99%

3.2. Factors Affecting Utilization Level of Combine Harvester

The results of analysis tests to determine factors related to the use of combine harvesters can be seen in Table 2. Table 2 shows the factors related to the use of combine harvesters, namely land area, relative advantage, compatibility, complexity, trialability, observability, and the role of farm extension workers. Meanwhile, factors that do not influence the use of a combine harvester are age, education level and length of farming. Here are brief explanation of them.

3.2.1. Farmer Age (X1)

The farmer's age has no relationship with the use of the combine harvester. Statistical analysis obtained a correlation coefficient value of 0.031 with a significance level of 0.776 which is greater than 0.10, so that is concluded that there is no relationship between farmer age and the level of combine harvester utilization by farmers. Based on conditions in the field, the average age of respondent farmers is in the productive category, namely 16-64 years, totaling 45 people or 84.91%. Therefore, age is not related to the utilization level of combine harvester in Negeri Katon District. Increasing age did not increase in the utilization level of combine harvester and the use of combine harvester was not determined by farmer age. This is in line with research by Febrimeli *et al*. (2022) in the Gomo District that farmer age factor did not influence tractor adoption, considering that the respondents were still in the productive age category. Nevertheless, the age positively affects the enthusiasm, motivation, and attitude of farmers towards agricultural mechanization. (Sahana *et al*., 2018) explain that middle age and young farmers work more efficiently, keenly participating in extension programs, very innovative, can take risk in applying farm machineries, and having more interest adopt mechanization.

Table 3. Distribution of respondent based on age class

No	Classification	Class Interval (year)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	Not yet productive	<15	0	0.00	0.00	0.00	0.00	0.00
2	Productive	16 – 64	45	84.91	0.00	62.26	22.64	84.91
3	Unproductive	>64	8	15.09	0.00	7.55	7.55	15.09
Total			53	100.0	0.00	69.81	30.19	100.0
Average : 53 years (productive)								

3.2.2. Formal Education Level (X2)

The test results of the relationship between level of education and utilization level of the combine harvester machine show that there is no significant relationship. The test results obtained a correlation coefficient value of 0.114 with a significance value of 0.247, greater than 0.10, so that the conclusion can be drawn to accept H0 and reject H1. The test results show that there is no relationship between the level of education and the utilization level of combine harvester machines by farmers. The average level of farmers education is of low category, namely elementary school, namely 34 people or 64.15%. Farmers get information about agricultural technology from extension workers and other farmers, not from formal education. This is in line with Anto & Shinta (2020) where formal education of the head of a household is not related to the level of adoption or the use of a combine harvester. The relationship between education and attitude was reported to be significant (Sahana *et al*., 2018). Highly educated individuals tend to seek out new information and technologies, which can enhance their socio-economic status. Most practices of farm mechanization require scientific knowledge and skills to adopt new technologies, and these are more readily embraced by farmers with a high formal education.

Table 4. Distribution of respondent based on education level

No	Classification	Number of Respondents		Score (%) utilization level for combine harvester			
		(people)	(%)	Low	Middle	High	Total
1	Preliminary school	34	64.15	0.00	45.28	18.87	64.15
2	High school	18	33.96	0.00	24.53	9.43	33.96
3	College-University	1	1.89	0.00	0.00	1.89	1.89
Total		53	100.0	0.00	69.81	30.19	100.0

3.2.3. Land Size (X3)

The test results of farmers' land area using the combine harvester show a real relationship. The test results obtained a correlation coefficient value of 0.506 with the significance level of this relationship being 0.000, which is smaller than 0.10, so that it can be concluded that accepting H1 and rejecting H0, shows that there is a relationship between land area and the level of use of Combine harvester machines by farmers. Based on conditions in the field, farmers have a fairly large land category, namely 0.5-1.00 ha, with 26 people or 49.06%. The larger the agricultural land owned by farmers, the more it will encourage farmers to use combine harvester machines in their farming activities. The existence of Combine harvester technology helps farmers shorten harvest time which only takes 2 hours/ha compared to using conventional harvesting methods which takes 1 week/ha. This is in line with the opinion of Rahmatunnisa *et al*. (2022) farmers who have large areas of arable land tend to want a greater level of convenience, especially in terms of harvesting their agricultural products, compared to those who have smaller arable land. Therefore, large land ownership can be a factor that increases motivation to adopt combine harvester technology.

Table 5. Distribution of respondent based on land holding size

No	Classification	Class Interval (ha)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	Small	<0.5	24	45.28	0.00	1.89	43.40	45.28
2	Slightly big	0.5 – 1.0	26	49.06	0.00	24.53	24.53	49.06
3	Big	>1.0	3	5.66	0.00	3.77	1.89	5.66
Total			53	100.0	0.00	30.19	69.82	100.0
Average : 0.53 ha (slightly big)								

(Sahana *et al*., 2018) reported that the size of land holdings showed a positive and significant association with farmer's attitude. This could be because farmers with larger land occupation consider agriculture as their primary occupation and aim for higher yields and economic gains, which can be achieved through mechanization adoption. Additionally, labor shortages are becoming a major problem, and farm mechanization is an attractive choice.

3.2.4. Experiences (X4)

The results of tests on farming experience and the level of use of combine harvester machines by farmers show that there is no real relationship. The test results obtained a correlation coefficient value of 0.080 with a significance level of this relationship of 0.456, greater than 0.10, it can be concluded that accept H0 and reject H1. The test results show that there is no relationship between the length of time farmers have been farming and the level of use of combine harvester machines by farmers. Based on conditions in the field, the experience of farmers in farming is in the medium category, namely 26-36 years, as many as 19 people (35.85%). Farmers' experience in farming has nothing to do with the use of combine harvester technology. Both farmers who have new and old experience in farming will encourage farmers to use combine harvesters if farmers feel they will benefit from combine harvester technology. This is also in line with research by Darwis (2020) which states that farming experience has an insignificant relationship with the level of farmers' application of the hazton planting system. (Sahana *et al*., 2018) reported that farming experience was linked to the farmers' attitudes toward mechanization. Farmers with more experience are better in evaluating the advantages and disadvantages of new technologies. Experienced farmers can understand better how proper utilization of mechanization can lead to improved yields and economic efficiency in farming.

Table 6. Distribution of respondent based on experiences

No	Classification	Class Interval (year)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	New (short)	15 – 25	17	32.075	0.00	26.42	5.66	32.075
2	Slightly long	26 – 36	19	35.850	0.00	24.53	11.32	35.850
3	Long	37 – 48	17	32.075	0.00	20.75	11.32	32.075
Total			53	100.0	0.00	71.70	28.30	100.0
Average : 31 years (middle)								

3.2.5. Relative Profit (X5)

The results of the relative profit test with the use of combine harvesters by farmers show that there is a real relationship. Based on the results of the tests that have been carried out, a correlation coefficient value of 0.650 is obtained with the significance level of this relationship being 0.000, which is less than 0.10, so that it can be concluded that accept H1 and reject H0, there is a relationship between relative profit and the level of use of combine harvester machines by farmers. Based on conditions in the field, farmers provide a relative profit value for the combine harvester machine in the profitable category. Farmers assess that using the combine machine is beneficial for farmers in terms of saving labor costs compared to harvesting using conventional methods, it can shorten harvest time because it only takes 2 hours on a 1 ha land area and the selling price of grain harvested using a combine harvester is more expensive, namely Rp. 4,700.00 compared to the conventional method of Rp.4,500.00 because the grain produced is cleaner. This is in line with research by Listiana *et al*. (2020) the use of a combine harvester provides benefits for farmers, because this tool significantly simplifies the rice harvesting process, reduces the duration of harvest time, reduces costs during the harvest process, and overcomes difficulties in finding workers during the main harvest period.

Table 7. Distribution of respondent based on relative profit

No	Classification	Class Interval (score)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	Unprofitable	4 – 6	1	1.89	0.00	1.89	0.00	1.89
2	Slightly profitable	7 – 9	5	9.43	0.00	9.43	0.00	9.43
3	Profitable	10 – 12	47	88.68	0.00	58.49	30.19	88.68
Total			53	100.0	0.00	69,81	30.19	100.0
Average : 10.98 (profitable)								

3.2.6. Suitability or Compatibility (X6)

The results of the compatibility test (suitability) with the use of the combine harvester by farmers show a real relationship. Based on the results of the tests that have been carried out, a correlation coefficient value of 0.312 is obtained with the significance level of this relationship being 0.006, which is smaller than 0.10, so that it can be concluded that accept H1 and reject H0. The test results show that there is a relationship between compatibility and the level of use of combine harvester machines by farmers. Based on conditions in the field of the combine harvester machine, farmers rated the compatibility of the combine harvester machine in the appropriate category as many as 34 people with a percentage of 64.15 percent. Farmers consider that the combine harvester is suitable for the conditions of the farmer's land which has dry and flat land conditions, the combine harvester machine is also in accordance with the needs of farmers because the combine harvester machine is really needed during the big harvest, is quite in accordance with the economic conditions of farmers and is quite in accordance with the cultural values of the community local. The higher the farmer's assessment of the compatibility of the combine harvester machine, the higher the level of farmer use of the combine harvester machine. In line with research by Abdullah *et al*. (2023) reveal that compatibility is a view seen by recipients of an innovation to assess the extent to which the innovation is compatible with and does not conflict with their environment. The more appropriate (suitable) an innovation is to certain environmental conditions, the more likely it is that the innovation will be accepted and adopted.

Table 8. Distribution of respondent based on machine suitability

No	Classification	Class Interval (score)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	Unsuitable	4 – 6	2	3.77	0.00	3.77	0.0	3.77
2	Slightly suitable	7 – 9	17	32.08	0.00	24.53	7.55	32.08
3	Suitable	10 – 12	34	64.15	0.00	41.51	22.64	64.15
Total			53	100.0	0.00	69.81	30.19	100.0
Average : 9.73 (suitable)								

3.2.7. Complexity (X7)

The results of the complexity test using the combine harvester by farmers show a real relationship. Based on the results of the tests that have been carried out, a correlation coefficient value of 0.582 is obtained with the significance level of this relationship being 0.000, which is less than 0.10, so that the conclusion can be drawn that accept H1 and reject H0. The test results show that there is a relationship between complexity and the level of use of combine harvester machines by farmers. Based on the conditions in the field of the combine harvester machine, 27 farmers rated the complexity of the combine harvester machine in the fairly easy category with a percentage of 50.94 percent. The combine harvester machine is easy for farmers to use, because the machine has 3 functions, namely cutting, threshing and separating grain from dirt, so it requires less labor compared to conventional methods. This research is in line with the opinion of Soekarwati (1998) in Baiti et al. (2023) that the easier it is for new technology to be put into practice, the faster the process of implementing the innovation will be carried out by farmers.

Table 9. Distribution of respondent based on machine complexity

No	Classification	Class Interval (year)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	Complex	4 – 6	0	0.00	0.00	0.00	0.00	0.00
2	Slightly easy	7 – 9	27	50.94	0.00	45.28	5.66	50.94
3	Easy	10 – 12	26	49.06	0.00	24.53	24.53	49.06
Total			53	100.0	0.00	69.81	30.19	100.0
Average : 9.32 (slightly easy)								

3.2.8. Trialability (Ease of Testing) (X8)

The results of the trialability test (ease of testing) with the use of the combine harvester by farmers show that there is a real relationship. Based on the results of the tests that have been carried out, a correlation coefficient value of 0.252 is obtained with the significance level of this relationship being 0.025, which is smaller than 0.10, which means accepting H1 and rejecting H0. The test results show that there is a relationship between complexity and the level of use of combine harvester machines by farmers. Based on conditions in the field, 37 people assessed the trialability of the combine harvester machine in the fairly easy category with a percentage of 69.21 percent. Using the combine harvester machine is quite easy for farmers to try because it suits the conditions of the farmer's land and helps farmers make harvest handling easier, can be used on narrow land, is quite easy to use on collapsed rice, and is quite easy to use during the rainy season. In line with research (Suganda *et al*., 2020), the positive perception or view of farmer members of the group towards testing the equipment is categorized as good, because the farmers believe that using the combine harvester machine will make the harvesting process easier in their rice fields. They consider it a practical tool and can be easily tested in the rice fields of members of the farmer groups who receive assistance.

Table 10. Distribution of respondent based on machine trialability

No	Classification	Class Interval (year)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	Difficult	4 – 6	0	0.00	0.00	0.0	0.0	0.0
2	Relatively easy	7 – 9	27	50.94	0.00	45.3	5.7	50.9
3	Easy	10 – 12	26	49.06	0.00	24.5	24.5	49.1
Total			53	100.0	0.00	69.8	30.2	100.0
Average : 9.32 (relatively easy)								

3.2.9. Observability (ease of observing the results) (X9)

The results of the observability test (ease of observing the results) with the use of the combine harvester by farmers show that there is a real relationship. Based on the results of the tests that have been carried out, a correlation coefficient value of 0.235 is obtained with the significance level of this relationship being 0.041, which is smaller than 0.10, so that it can be concluded that rejecting H0 and accepting H1 means that there is a relationship between observability and the level of use of combine harvester machines by farmers. Based on conditions in the field, the farmers' assessment of the

observability of the combine harvester machine in the fairly easy to observe category resulted in 28 people or 52.83%. Farmers can differentiate the quality of grain using a cleaner combine harvester machine compared to using conventional methods. This research is in line with the research of Rahayu & Herawati (2021), observability is the nature of innovation so that it can be observed by potential adopters of innovation, so that based on these observations it will result in a decision to adopt an innovation or not.

Table 4. Distribution of respondent based on observability

No	Classification	Class Interval (year)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	Difficult	4 – 6	25	47.17	0.00	32.08	15.09	47.17
2	Relatively easy	7 – 9	28	52.83	0.00	47.17	5.66	52.83
3	Easy	10 – 12	0	00.00	0.00	0.00	0.00	0.00
Total			53	100.0	0.00	79.25	20.75	100.0
Average : 8.50 (relatively easy)								

3.2.10. Role of Farm Extension Workers (X10)

The results of testing the role of farm extension workers with the level of use of combine harvester machines by farmers show that there is a quite real relationship. Based on the results of the tests that have been carried out, a correlation coefficient value of 0.677 is obtained with the significance level of this relationship being 0.080, which is smaller than 0.10, so that it can be concluded that accept H1 and reject H0. The test results show that there is a relationship between the role of farm extension workers and the level of use of combine harvester machines. Based on conditions in the field, extension workers act as a liaison between the government and farmers in obtaining agricultural production facilities. Agricultural instructors also play a role in motivating farmers to cultivate good crops, one of which is by harvesting on time. The combine harvester machine is a machine that helps farmers speed up harvest time and overcome difficulties in finding harvest workers so that farmers can harvest on time. In line with research (Purnamawati *et al*., 2021) farm extension workers have provided the idea of using a combine harvester to harvest on time during the main harvest. This is because during the main harvest the harvest time is often delayed as a result of a lack of labor.

Table 4. Distribution of respondent based on role of extension workers

No	Classification	Class Interval (year)	Number of Respondents		Score (%) utilization level for combine harvester			
			(people)	(%)	Low	Middle	High	Total
1	Less significant	10 – 16	25	47.17	0.00	32.1	15.1	47.2
2	Relatively easy	17 – 23	28	52.83	0.00	37.1	15.7	52.8
3	Easy	24 – 30	0	00.00	0.00	0.0	0.0	0.0
Total			53	100.0	0.00	69.2	30.8	100.0
Average : 6.69 (less significant)								

4. CONCLUSION

The utilization level of combine harvester machine by farmers has been analyzed based on three components, namely plant requirements, land requirements, and machine application rate. Based on plant condition requirements component, the utilization of combine harvester was classified as good category with an average score of 5.75. Respondent farmers always harvest using combine harvester at the optimum age of rice, during day time when the plants are dry. From the component of land condition requirements, the utilization of combine harvester was classified as fairly good category with an average score of 4.01. Respondent farmers believed that the land is ready for rice harvest, but farmers never inspect the land for any obstacle (stones, wood, hard materials) that may damage the combine harvester machine before harvesting activity. From the machine application rate component, the utilization of combine harvester was categorized as poor with an average score of 3.24. The intensity of farmers in using the combine harvester was 3-4 times out of 5 harvest seasons. In addition, farmers were not skilled in operating the machine, so they hire operator from outside the farmer group to operate the combine harvester. A few respondent farmers who got training from government body had

very limited skills and unconfident in operating the machine. Factors related to the utilization level of combine harvester machine have been identified and analyzed. Some factors significantly influenced the utilization level of combine harvester, including land holding size, relative profit, machine compatibility, machine complexity, machine trialability, result observability, and the role of farm extension workers. Other factors such as farmer age, formal education, and experiences, did not influenced the utilization level of combine harvester.

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REFERENCES

Abdullah, A.A., Imran, S., & Sirajuddin, Z. (2023). Adopsi inovasi pupuk organik untuk pengelolaan lingkungan berkelanjutan di Kecamatan Tilongkabila Provinsi Gorontalo. *Jurnal Ilmiah Membangun Desa dan Pertanian*, ***8***(3), 102–109. https://doi.org/10.37149/jimdp.v8i3.362

Amrullah, E.R., Pullaila, A. (2020). Dampak penggunaan *combine harvester* terhadap kehilangan hasil panen padi di Provinsi Banten. *Jurnal Agro Ekonomi*, ***37***(2), 113-122. https://doi.org/10.21082/jae.v37n2.2019.113-122

Anisa, S., Suharyatun, S., Oktafri, O., dan Asmara, S. (2018). Unjuk kerja mesin pemotong padi (paddy mower) saat pemanenan padi (*Oryza sativa* L.) di lahan basah. *Jurnal Teknik Pertanian Lampung*, ***7***(2), 97-105. https://doi.org/10.23960/jtep-l.v7i2.97-105

Anto, A., & Shinta, E. (2020). Korelasi karakteristik sosial ekonomi petani dengan tingkat adopsi *combine harvester* pada usahatani padi lahan pasang surut di Kabupaten Pulang Pisau. *Jurnal AGRI PEAT*, ***21***(1), 11–19.

Anwar, A. (2009). *Statistika untuk Penelitian Pendidikan dan Aplikasinya dengan SPSS dan Excel*. IAIT Press, Kediri.

BPP Mektan (Badan Penelitian dan Pengembangan Mekanisasi Pertanian). (2016). *Buku Panduan Penggunaan Mesin Mini Combine Harvester*. Balai Besar Pengembangan Mekanisasi Pertanian, Jakarta: 14 pp.

Baiti, N.N., Suminah, S., & Winarno, J. (2023). Hubungan tahapan dalam proses keputusan inovasi transplanter padi bagi petani di Kecamatan Trucuk, Kabupaten Klaten. *Jurnal Multidisiplin West Science (JMWS)*, ***2***(02), 89–102. https://doi.org/10.58812/jmws.v2i02.204

Darwis, K. (2020). Hubungan karakteristik sosial ekonomi petani padi dengan tingkat adopsi inovasi sistem tanam hazton di Desa Malalin Kabupaten Enrekang. *Agrokompleks*, ***20***(2), 28–35. https://doi.org/10.51978/japp.v20i2.217

Durroh, B. (2020). Efektivitas penggunaan mesin panen (combine harvester) pada pemanenan padi di Kabupaten Bojonegoro. *Sinta Journal*, ***1***(1), 7-12.

Fahroji, F., & Zulfia, V. (2014). *Petunjuk Teknis Pascapanen Padi*. Balai Pengkajian Teknologi Pertanian Riau.

Febrimeli, D., Siregar, A.Z., & Laia, T.J. (2022). Adopsi petani dalam penggunaan traktor roda dua mengolah lahan padi sawah Di Kecamatan Gomo Kabupaten Nias Selatan Provinsi Sumatera Utara. *Jurnal Sosial Ekonomi Pertanian*, ***18***(2), 117–128.

Hapsari, H., Rasmikayati, E., & Saefudin, B.R. (2019). Karakteristik petani dan profil usahatani ubi jalar di Kec. Arjasari, Kab. Bandung. *Sosiohumaniora*, ***21***(3), 247–255. https://doi.org/10.24198/sosiohumaniora.v21i3.21288

Hasanah, S.N. (2022). *Pemanfaatan Combine Harvester Dalam Proses Pemanenan Padi Di Kecamatan Mungkid Kabupaten Magelang*. (Report for Field Cooperation I). Politeknik Enjinering Pertanian Indonesia, Serpong.

Hermanto, H., Ashari, A., Tarigan, H., Dabukke, F.B.M., & Rachmita, A.R. (2018). Optimalisasi Pemanfaatan Bantuan Alat dan Mesin Pertanian dan Dampaknya Terhadap Peningkatan Produksi. [*Laporan Analisis Kebijakan*]. Pusat Sosial Ekonomi dan Kebijakan Pertanian, Sekretariat Jenderal Kementerian Pertanian, Jakarta: 27 pp.

Kementerian Pertanian (2022a). Keputusan Direktur Jenderal Prasarana dan Sarana Pertanian Nomor 45.1/SR.440/B/11/2022 Tentang Petunjuk Teknis Kegiatan Pengembangan Perbengkelan Alat dan Mesin Pertanian Untuk Mendukung Poktan/Gapoktan/Pokja Di Daerah Sentra Produksi Pertanian Tahun Anggaran 2023.

Kementerian Pertanian (2022b). Keputusan Direktur Jenderal Prasarana dan Sarana Pertanian Nomor 45.2/KPTS/SR.430/B/11/2022

Tentang Petunjuk Teknis Penyediaan dan Penyaluran Bantuan Alat dan Mesin Pertanian Tahun Anggaran 2023.

Kementerian Pertanian (2023). Keputusan Direktur Jenderal Prasarana dan Sarana Pertanian Nomor 34.3/KPTS/SR.430/B/12/2023 Tentang Petunjuk Teknis Penyediaan dan Penyaluran Bantuan Alat dan Mesin Pertanian Tahun Anggaran 2024.

Listiana, I., Rangga, K.K., Anggoroseto, P., & Purwatiningsih, N.A. (2020). Respons petani terhadap penggunaan *combine harvester* pada waktu panen padi sawah di Kabupaten Pringsewu Provinsi Lampung. *Pengkajian dan Pengembangan Teknologi Pertanian*, ***23***(3), 259–269.

Manyamsari, I., & Mujiburrahmad, M. (2014). Karakteristik petani dan hubungannya dengan kompetensi petani lahan sempit. *Agrisep*, ***15***(2), 58–74.

Molenaar, R. (2020). Panen dan pascapanen padi, jagung dan kedelai. *Jurnal Eugenia*, ***26***(1), 17–28.

Pradnyawati, I.G.A.B., & Cipta, W. (2021). Pengaruh luas lahan, modal dan jumlah produksi terhadap pendapatan petani sayur di Kecamatan Baturiti. *Ekuitas: Jurnal Pendidikan Ekonomi*, ***9***(1), 93. https://doi.org/10.23887/ekuitas.v9i1.27562

Prasetia, R., Hasanuddin, T., & Viantimala, B. (2015). Peranan kelompok tani dalam peningkatan pendapatan petani kopi di Kelurahan Tugusari Kecamatan Sumberjaya Kabupaten Lampung Barat. *Jurnal Ilmu-Ilmu Agribisnis (JIIA)*, ***3***(3), 301–307.

Prastisi, I.A., Listiana, I., Yanfika, H., & Silviyanti, S.S. (2023). Knowledge level of rice farmers on transplanter innovation in the Sinar Kencana II Farmers Group Bumi Kencana Village. *Jurnal Penelitian Pertanian Terapan*, ***23***(1), 110–118. https://doi.org/10.25181/jppt.v23i1.2326

Purnamawati, T., Gitosaputro, S., Effendi, I., Silviyanti, S., Listiana, I., dan Yanfika, H. (2021). Peran penyuluh pertanian dalam penggunaan combine harvester di Kecamatan Purbolinggo Kabupaten Lampung Timur. *Journal of Food System and Agribusiness*, ***7***(1), 77-88. http://dx.doi.org/10.25181/jofsa.v7i1.2331

Rahayu, H.S.P., & Herawati, H. (2021). Keberlanjutan penerapan teknologi padi sawah ramah lingkungan dalam aspek kapasitas petani dan sifat inovasi di Sulawesi Tengah. *Jurnal Penyuluhan*, ***17***(2), 228–236. https://doi.org/10.25015/17202133534

Rahmatunnisa, W.R., Rahmaddiansyah, & Agussabti. (2022). Faktor-faktor yang mempengaruhi adopsi petani terhadap teknologi *combine harvester*. *Jurnal Ilmiah Mahasiswa Pertanian*, ***7***, 598–616.

Sahana, S., Shashikiran, A.C., & Gayathri, G.N. (2018). Attitude and factors affecting the attitude of farmers towards farm mechanization in paddy. *Multilogic in Science*, ***VIII***(XXV), 102-105.

Suganda, M.R., Rangga, K.K., & Listiana, I. (2020). Persepsi petani terhadap pemanfaatan bantuan *combine harvester* di Kecamatan Gadingrejo Kabupaten Pringsewu. *Jurnal Agribisnis Terpadu*, ***13***(1), 154. https://doi.org/10.33512/jat.v13i1.7541

Sulaiman, A.A., Herodian, S., Hendriadi, A., Jamal, E., Prabowo, A., Prabowo, A., Mulyantara, L.T., Budiharti, U., Syahyuti, S., & Hoerudin, H. (2018). *Revolusi Mekanisasi Pertanian Indonesia*. IAARD Press, Badan Penelitian dan Pengembangan Pertanian, Jakarta: 274 pp.

Yohanna, J.K., Fulani, A.U., & Aka'ama, W. (2011). A survey of mechanization problems of the small scale (peasant) farmers in the Middle Belt of Nigeria. *Journal of Agricultural Science*, ***3***(2), 262-266. https://doi.org/10.5539/jas.v3n2p262

Zakky, M., Pitoyo, J., & Prayoga, A. (2021). Unjuk kerja mesin pemanen padi (*Oryza sativa*) kombinasi mini (mini *combine harvester*). *Jurnal Teknik Pertanian Lampung*, ***10***(3), 303-308. https://doi.org/10.23960/jtep-l.v10i3.303-308