Farmer’s decision determining factors in harvest technology selection in rice farming

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Abstract. Development of modern agricultural sector requires agricultural tools and machinery. Agricultural equipment and machinery technology is considered capable of increasing agricultural production and efficiency of time and labor. Furthermore, farmers’ decision on agricultural mechanization usage is influenced by internal and external factors. The recent study aims to determine the influencing factors toward farmer’s decision in harvest technology selection in rice farming. The research was conducted in Seputih Raman District, Central Lampung Regency in September – October 2016. The farmer’s decision determining factors were analyzed using binary logistic regression. As a result, the determining factors were the ease of operating rice harvester machines and land ownership status by farmers. However, new technology requirements are easy to adopt, one of which is the ease of testing. Therefore, technically harvester machine assembling is not complicated and easy to operate.

1. Introduction

The development of the agricultural sector is vital to be implemented in Indonesia, considering Indonesia is an agricultural country. Agricultural development in the State Direction Outline aims to increase food production, improve farmers’ living standards, expand jobs, increase exports and reduce imports, increase support for industrial development, utilize and maintain natural resources and the environment and increase rural development growth. The use of agricultural machinery is necessary for the development of the agricultural sector to increase food production. According to Hardjosentono et al. [1], the role of agricultural mechanization in agricultural development in Indonesia is: (a) to enhance human power efficiency; (b) to improve farmers’ life degree and standard; (c) to ensure an increase in the quantity and quality as well as agricultural production capacity; (d) to allow the growth of farming types, from subsistence to commercial farming; (e) to accelerate the transition of Indonesia’s economy from agrarian to industrial nature.

Harvesting technology in the form of agricultural mechanization that has been introduced to farmers is a harvesting machine called combine harvester. The combine harvester is a modern harvester machine that is used to harvest cereal crops. It has the principle to combine cutting, threshing, drying grain, and breaking straw in one operation [2]. The high yield loss during harvest
and post-harvest rice due to scattering is a significant problem to date. According to Ananto et al. [3], the rate of rice yield loss during post-harvest handling reaches 20-21%, with the most significant occurring in harvesting, which is around 9% and at threshing around 5%. The yield loss data for 2005-2007 has decreased to 10.82 percent. The application of modern harvest and post-harvest technology can reduce yield losses and is a source of prospective production growth [4]. Combining cutting, threshing, drying grain, and breaking straw in one operation can reduce yield losses by only 1.87% (Priyadi, 2016) [5]. Apart from yield losses, the efficient use of labor and harvest time determines factors in the application of technology. Harvesting technology with a combined harvester can reduce labor use, time, and cost efficiency and minimize crop losses and better grain quality to increase rice production. According to Hindiani (2013) [6], combining harvester is more efficient, as it is faster and cheaper in terms of rental price and the use of harvest labor.

The advantages of using a combined harvester do not make this technology preferred by farmers. Various factors influence farmers' decisions in using harvest technology. External and internal factors greatly influence farmers' decisions in choosing the harvest technology. According to Hanafie (2010), the application of post-harvest technology is influenced by several factors, especially in terms of tool characteristics, ease of use, product yield, and ease of access, which will significantly influence farmers the technology used [7]. This study aims to determine the factors influencing farmers' decisions to apply harvest technology using a combined harvester.

2. Research methods

3. Time and location
The research was carried out in Rejo Asri Village, Seputih Raman District, Central Lampung Regency. The research was conducted from August to September 2016.

3.1. Data collection
Location was purposively chosen because Central Lampung Regency is a center for rice production and the density of agricultural machine users, particularly combine harvester. Respondents involved were 74 lowland rice farmers who are members of Gapoktan Subur Asri. The farmers' group was chosen due to the ownership of agricultural equipment and machinery. The data used are primary data research taken in Central Lampung Regency by direct interview method using a semi-structured questionnaire. The data consists of the characteristics of the respondent and the farm.

3.2. Methods of data analysis
Technology adoption by farmers is a critical aspect of the problem of agricultural mechanization. Technical, social, and economic factors are reasons farmers use agricultural machine tool technology such as tractors [8]. The factors that determine farmers of choosing combine harvester are analyzed using binary logistic regression with the following equation:

\[
\log \frac{P_i}{1-P_i} = \sum \alpha_i X_i + \beta
\]

\(P_i\) = Opportunity for a farmer I to harvest rice using a combine harvester, where \(P_i = 1\) for farmers who use a combine harvester and \(P_i = 0\) for farmers who do not use a combine harvester.

\(X_i\) = independent variable, namely the factors that are thought to affect the use of the combine harvester where:


X1 = Age of farmer (years)
X2 = Farmer education (years)
X3 = Number of family members (people)
X4 = Number of family members who help farming (people)
X5 = Farming experience (years)
X6 = Agricultural income (IDR / season)
X7 = Land area (Ha)
X8 = Land tenure status (1 = Owned, 0 = non owned)
X9 = Ease of operating a combine harvester (1 = easy, 2 = difficult)
α = Estimated parameter
βi = Constant

4. Results and discussion

4.1. Characteristics of respondent farmers

Characteristics of farmers identified were: age, education, farming experience, number of family members, and land area ownership. Description of farmer characteristics is presented in table 1. The respondent farmers have an average age of 46 years, with the oldest age is 68 years, and the youngest is 21 years old. The generation of farmers is related to physical ability, maturity in farming, and speed in responding and adopting introduced innovations. The younger the farmer, the more physical ability in farming and quicker in responding and adopting innovations.

| Characteristics               | Max  | Min  | Average |
|-------------------------------|------|------|---------|
| Age                           | 68   | 21   | 46      |
| Education                     | 15   | 6    | 9       |
| Farming Experience            | 43   | 1    | 4       |
| Number of Family Members      | 9    | 2    | 15      |
| Land Area                     | 2    | 0.125| 0.5     |

The education pursued by farmers in this study is formal education. Average farmer education is nine years or equivalent to Junior High School. The lowest education taken by farmers is six years (Elementary School), and the highest education taken is 15 years. The level of education influences the mindset, acceptance of innovation, and technology transfer to facilitate the entry of technological innovations beneficial for the farming being run [9]. Respondent farmers have an average of 4 years of farming experience. The farming experience affects the farmer's mindset in farming. Farmers with more vast experience will be more mature in making decisions in farming. The average number of farmer family members is 15, with a minimum of 2 members and a maximum of 9 people. The average area of land owned by farmers is 0.5 ha, with the most significant area is 2 ha, and the smallest is 0.125 ha.

4.2. Farmer's decision determining factors to choose combine harvester
The analysis result of the binary logistic regression model is presented in table 2. Based on the results of Negelkerke R Square value analysis of 0.523, the independent variable can explain the dependent variable, namely the farmer's decision to use a *combined harvester* of 52.3 percent. The Negelkerke R Square is the same as R Square in linear regression. The factors determining the farmer's decision to choose a combine harvester as a harvesting tool are pretty good in explaining the model. This is indicated by the value of Hosmer and Lemeshow's goodness of fit of 7.898. This value has a significance of 0.44, more remarkable than 0.05, which suggests the model's goodness. Nine variables influence farmers' decisions to choose harvest technology. Two of the nine variables affect the farmers' decision to choose harvest technology using the combine harvester. At the same time, the other seven variables have no significant effect. The variables of land status and ease of operating the combine harvester have a significant and positive effect on the farmers' decision to choose the combine harvester as a rice harvesting tool.

**Table 2.** Results of analysis of binary logistic regression model.

| Description                                      | Parameters Alleged |
|--------------------------------------------------|--------------------|
| Constant                                         | -5.022             |
| Age Farmers                                      | -0.005             |
| Education                                        | -0.050             |
| number of family members (people)                | 0.317              |
| Number of family members who help to farm (vote) | -0.193             |
| farming experience (years)                       | -0.039             |
| farm incomes ( Rp / season)                      | 0.000              |
| Land area (Ha)                                   | 2.337              |
| Land Mastership Status                           | 1.649 *            |
| Ease of operating a *combine harvester*          | 3.664 *            |
| Cox & Snell R Squere                             | 0.351              |
| Negelkerke R Squere                              | 0.523              |
| Hosmer and lemeshow goodness of fit              | 7.898              |
| -2 Log L (constant only)                         | 50.168             |
Land ownership status has a positive and significant effect on farmers’ decisions to choose to combine harvester. This shows that farmers who have their land status can easily decide to use a combine harvester as a harvesting tool. Farmers who own land are more flexible in making decisions in technological innovations, while smallholders must first ask the landowner (landlords) for consideration to implement technological innovations. According to Supadi (2008) [10], a tenant's exploitation/management of farmland is relatively the same as that of the tenant owner, while the landowner largely influences the tenant's decision making. The same statement was also conveyed by Padillah (2020) [11], landowners with self-owned status have complete supervision over the implementation of their farming when compared to farmers whose land status is for the results. The owners decide to adopt innovation according to their consideration. This is different from the research results by Wangke et al. (2011) [12] that the land tenure status between the owner and the owner has no significant effect on the application of rice farming technology.

The ease of machine operation has a positive and significant effect on the farmers' decision to choose a combine harvester as a tool for harvesting rice. Machine characteristics and ease of use are a consideration in selecting agricultural machinery. In line with the research of Indraningsih et al. (2005) [13] that one of the reasons for respondent farmers to apply post-harvest technology is the suitability of machinery (technical aspects) as much as 24%. According to Hanafie (2010) [7], the application of post-harvest technology is influenced by several factors, especially in terms of tool characteristics, ease of use, products produced, and ease of access, which will significantly affect farmers in choosing the technology to be used. One of the requirements for technology to be accepted and adopted is that it is easy to apply. The technology requires expertise in operating so that ease of operation will increase users who will take advantage [14]. Farmers will take into account technological innovations that are easy to operate. Therefore it is necessary to have a strategy to choose the right innovation to utilize. According to Musyafak and Ibrahim (2005) [15], there are specific criteria as a strategy for selecting the right innovation, including a). Innovation should be perceived as a necessity by most farmers b). Innovation must provide concrete benefits for farmers c). Innovations must have compatibility d). Innovation must be able to overcome the limited factors e). Innovation must utilize existing resources f). Innovation must be affordable to farmers' financial capacity g). Innovations must be simple, uncomplicated and easy to try and h). The innovation must be easy to observe.

Age has no significant effect on the farmer's decision to combine harvester as a harvesting tool. In line with the research of Hayati and Maisaroh (2019) [16], the decision to choose agricultural commodities is not influenced by the age of farmer because farmers think that farming activities do not depend on age, but instead on the skills or tenacity of the farmers themselves in farming. The farmer's decision to choose a combine harvester as a harvesting tool is not influenced by farmer education. This means that the level of education will not affect the farmer's decision to use a combined harvester. The average education of farmers in the research location is taken for nine years, equivalent to Junior High School. The variables of the number of family members, the number of members who help to farm, the experience of farmers, agricultural income, and land area have no significant effect on the farmers' decision to choose the use of the combine harvester as a rice harvesting tool. In line with the results of Setiawati's (2016) research [17], the variables of age, education, number of family dependents, farmer experience, total income, and land area have no significant effect on the decision to adopt rice technology.

The odds ratio more than five, including land area, land tenure status, and ease of operating the combine harvester. The land has an odds ratio of 10 351, indicating that farmers choosing to use a combine harvester will increase to 10,4 times if the land ownership is wider. Lionberger in Burhansyah (2014) [18] states that the wider the land control, the faster it is adopted because it has better economic capacity. Chi (2010) [19] revealed one of the critical factors influencing harvest and post-harvest mechanization island areas. The variable of land tenure status has an odds ratio of 5,200,
indicating that the opportunity for landowners to choose to use a combine harvester will increase 5.2 times compared to smallholders. The ratio value for the odds ease of operating a combine harvester is 39,004, indicating that the opportunity for farmers to choose to use a combine harvester will increase to 39 times if it is technically easier to operate.

5. Conclusion
Factors affecting farmers’ decisions in choosing harvest technology are land tenure status and the ease of operating the harvesting machines.

6. Policy implications
The farmers’ decision to choose harvest technology is influenced by land tenure status and the ease of operating harvesting machines. Therefore the government in distributing combine harvester harvesters is prioritized to farmers who have land tenure status as owner farmers so that they are easy to make decisions to adopt the technology. Ease of operation is also a consideration for engineers to create simple and easy to operate machines.

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