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Farmers' Willingness to Pay Bio-Activators to Maintain Soil Fertility

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Abstract

How farmers are willing to pay bio-activators needs to be studied. The purposes of this study are to analyze the knowledge and use of bio-activators, as well as the willingness to pay for bio-activators in rice farming. The research was conducted in Malang Regency, with a sample of 82 farmers from Ngajum and Gondanglegi Districts. Data were analyzed by descriptive and multiple linear regression. The results showed that the farmers are aware of one to four brands of bio-activators, and three of the brands are used by the rice farmers. The benefits of using bio-activators that are mostly perceived by rice farmers are fertilizing the soil and plants, thereby increasing the production of rice farming. Willingness to pay for bio-activators is based on the prevailing market price, there is no willingness to pay a premium price. Factors that have a positive effect on willingness to pay are land area and benefits of bio-activators. The wider the agricultural land owned by the farmer and the greater the perceived benefits, the greater the value of willingness to pay will be. This information can be taken into consideration for manufacturers of bio-activators as a new introduction before being released in the market.

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INTRODUCTION

Bio-activators (BA) is a bioactive material from microbes that is able to degrade organic materials in the soil (Shohib, 2020; Ulhasanah et al., 2022), hence, it can improve soil structure, provide soil nutrients, and is environmentally friendly (Franco Junior et al., 2019). In agricultural cultivation, the use of BA has long-term benefits since it improves soil structure and fertility (Shohib, 2020). Accordingly, it is also expected to increase crop production (Anisuzzaman et al., 2021; Rahmad et al., 2019).

Soil improvement is beneficial for the preservation of natural resources, namely agricultural land as a tool for producing the needed food. Soil that is given the application of organic materials contributes to maintaining environmental sustainability (Farikhah et al., 2018). Environmental sustainability efforts require the support of consumers/product users, consequently, the concept of willingness to pay (WTP) arises. WTP is a willingness to pay more for products contributing to environmental care (Tully & Winer, 2014).

Farmers as users of BA products certainly have a goal to increase production. This is because production is a benefit that can be used in the short term. If BA can increase production and improve the environment, the farmers are willing to pay a higher price for the products (WTP) than chemical products. These two sides of interest (farm production and WTP for pro-environmental products such as BA) must receive the support of scientific studies in order to find compatible conditions.

Previous research on bio-activators has found a lot of aspects. For example, BA is greatly helpful in making liquid organic fertilizer from chicken manure and the results are effective in the growth of tomato plants. Meanwhile, BA EM4 is effective in composting banana leaves (Ulhasanah et al., 2022). Furthermore, the usage of Arbuscular Mycorrhizal Fungi (AMF) and BA is proven to increase soybean growth and production (Yudhiarti et al., 2020). Moreover, the use of BA can reduce nematode interference in coffee cultivation (Franco Junior et al., 2019). In addition, the utilization of BA combined with vermicompost also increases the production of mustard greens (Wahyudin & Irwan, 2019). In Malaysia, the use of organic fertilizers combined with inorganic fertilizers is also able to escalate rice production and support soil health (Anisuzzaman et al., 2021). Nevertheless, various previous studies that have been traced in Indonesia have not examined the use of BA in rice farming, whereas information about the benefits of BA in rice farming is crucial since the food crop farmers are still oriented to rice cultivation.

In Malaysia, farmers use BA more in vegetable and agricultural crops other than rice (Priyadi et al., 2022). However, Shivanand & Taha (2022) have also recommended the use of BA in rice because it can help produce more and better-quality rice. Moreover, when compared to Indonesia especially, the farmers in Malaysia also utilize biofertilizers in restoring water quality in aquaponics integration (Saufie et al., 2022). According to the study of Doni et al., (2018), the benefit of using BA, such as Rhizoctonia sp, is as a biofertilizer to increase rice production.

In fact, rice farmers in Malang Regency have also been introduced to BA and some have used BA. From the results of the investigation through the internet network and field observations, it was found that agricultural shops in Malang Regency had provided (sold) several trademarks. Indeed, BA will attract farmers to adopt it if it is proven to increase economic benefits (profits). Accordingly, the first novelty of this study is to examine the benefits of using BA in rice farming.

WTP on environmentally friendly products is more expensive than products that are not environmentally friendly (Ariadi et al., 2021; Rahayuningsih & Tain, 2021; Relawati et al., 2021). In general, the attitude of environmental awareness has a positive effect on purchasing decisions and the WTP of environmentally friendly products (Ariadi et al., 2021; Kai et al., 2013). Unless WTP is measured by price increases from current prices, environmental awareness does not affect WTP since the quality factor of organic products is more influential (Relawati et al., 2022).

Furthermore, research on organic fertilizers in Ghana and Europe shows that WTP is high enough to support environmentally friendly or socially responsible commercial products (Jones et al., 2009; Kuwornu et al., 2017; Tully & Winer, 2014). The factors that have a positive effect on the WTP of organic fertilizer are farmer education, farm area, farmer income and marital status, while the age of the farmer has a negative effect on WTP (Etim & Benson, 2016).

Research on environmentally friendly products including organic fertilizers has produced several findings, however, WTP on organic fertilizers which includes bio-activators has not been widely studied in Indonesia. As a result, the second novelty of this study is to examine the factors that influence the WTP of bio-activators applied to rice farming. Accordingly, the aims of this study are 1) to analyze the knowledge and experience of farmers in the use of bio-activators, and 2) to analyze the factors that influence the WTP of bio-activators to maintain soil fertility in rice farming.

RESEARCH METHODS

Bio-activator is a new innovation for the majority of farmers. The advantage of BA is to improve soil fertility with bioactive ingredients so that it is environmentally friendly and has long-term benefits. With the benefits of fertilizing the soil, BA can increase crop production. On the other hand, the use of BA means increasing farming costs. If the price of BA is affordable, the additional costs of farming can be replaced by the benefits obtained.

The response of farmers to BA innovation is based on the consideration of several factors. First of all, farmers' knowledge of BA is the most basic thing. Essential knowledge that must be known by farmers is about the presence of BA in the market and the benefits that can be obtained. Furthermore, if farmers have the purchasing ability and power, they can adopt BA easily. One measure of a farmer's economic capacity is the area of land controlled/owned. If farmers have the willingness to pay BA, adoption occurs. Accordingly, it is expected that in the future a cycle of farmer response to BA will occur so that the use of BA is more widespread among farmers. A visual explanation of the framework of thinking is depicted in Figure 1.

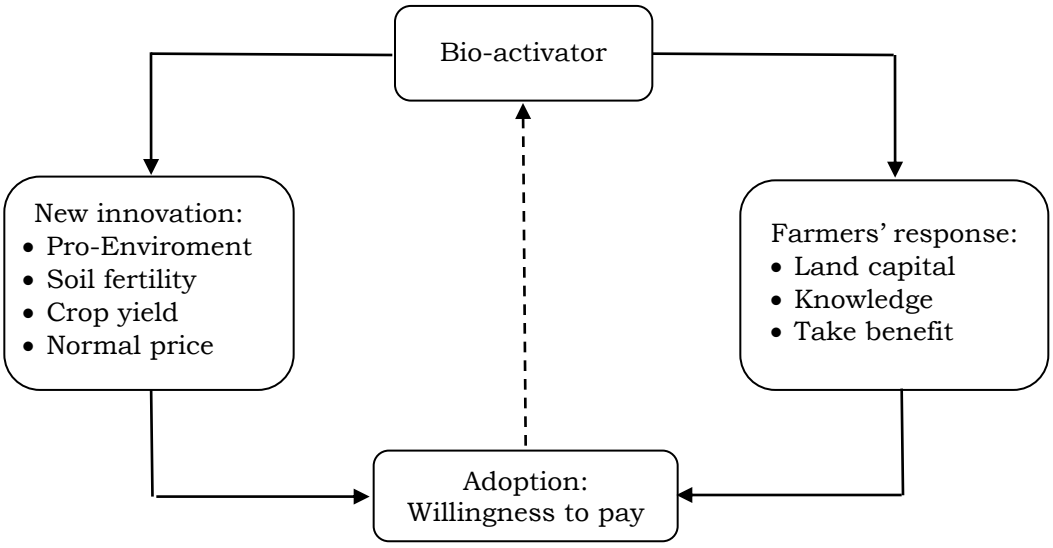


Figure 1. Conceptual framework

This study was conducted in Malang Regency. The sampling technique employed was multistage sampling. The first stage was choosing two sub-districts, namely Ngajum and Gondanglegi Districts. The second stage was to select villages, namely Ngajum Village, Ngajum District and Gondanglegi Village, Gondanglegi District. The third stage was electing farmers by stratified sampling. The strata were determined based on the area of rice planted. The total number of sample farmers was 82 rice farmers using bio-activators, namely 40 people in Ngajum and 42 people in Gondanglegi.

Objective 1 was analyzed descriptively quantitatively, by presenting the data graphically and in cross tables. The description was carried out on the knowledge of farmers about the types of bio-activators available in the market and their experience using these bio-activators. The second objective was analyzed using multiple linear regression, to examine the influence of farmer characteristics factors that affect the willingness to pay bio-activators. The regression model is formulated as follows:

$$WTP = a + b_1Land + b_2Know + b_3Ben + e$$

Where:

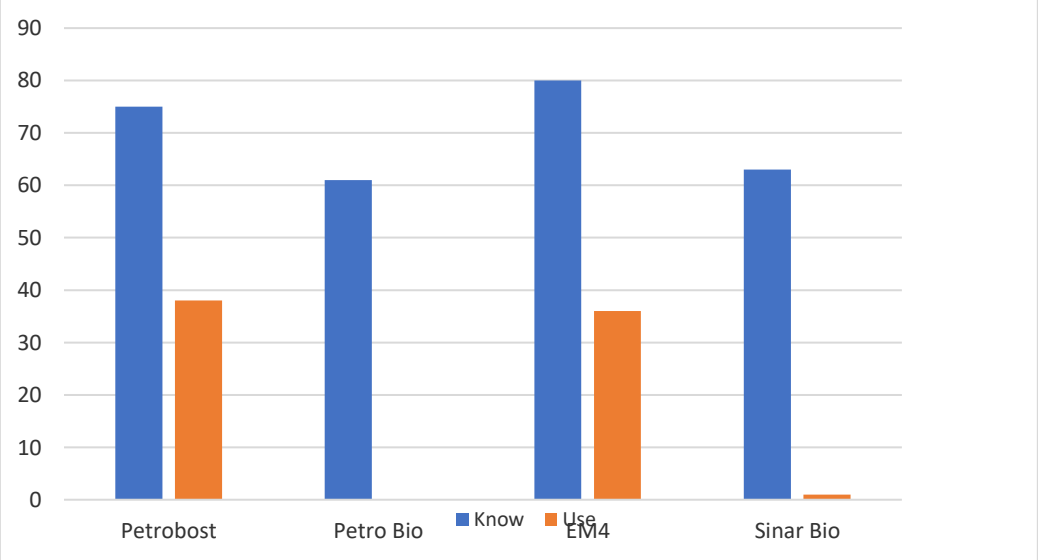
WTP = willingness to pay (Rupiah)
Land = Land large (ha)
Know = Number of bio-activator known (1 until 4 brands)
Ben = Benefit of bio-activator (1 = no benefit; 2 = fertilize soil or fertilize crops; 3 = increase yields)

RESULTS AND DISCUSSION

Knowledge and Experience of Farmers in the Use of Bio-activators

The results of field observations indicated that there were four brands of bio-activators sold in agricultural shops in Ngajum and Gondanglegi Districts. Information about the availability of bio-activator brands was not evenly distributed among farmers who already used them. Even many of the farmers who have not used bio-activators were also unaware of the availability of these products in farm shops. Farmers who understood the availability of certain brands of bio-activators also did not always use them. The distribution of farmers based on their knowledge of bio-activator brands in farm shops and their use is presented in Graph 1.

Graph 1 shows that four brands of bio-activators are available in farm shops. The most known brand to respondent farmers is EM4, followed by Petrobost, Sinar Bio, and Petro Bio (blue color) respectively. Furthermore, the most used brand is Petrobost, followed by EM4 and Sinar Bio (orange color) sequentially. The Petro Bio brand is not found to be used by rice farmers who are the research respondents. It is essential for farmers to know the availability of commercial BA brands in farm shops to enable the adoption of BA innovations. According to Kuntariningsih & Mariyono (2014), farmers adopting a new innovation will see their experiences and the experiences of others. As a new innovation, farmers in the research area have not observed many other farmers using it, thus there have not been many good experiences from other farmers. Hilmiati (2020) stated that efforts to accelerate the adoption of innovations can be carried out through groups to ensure its sustainability.



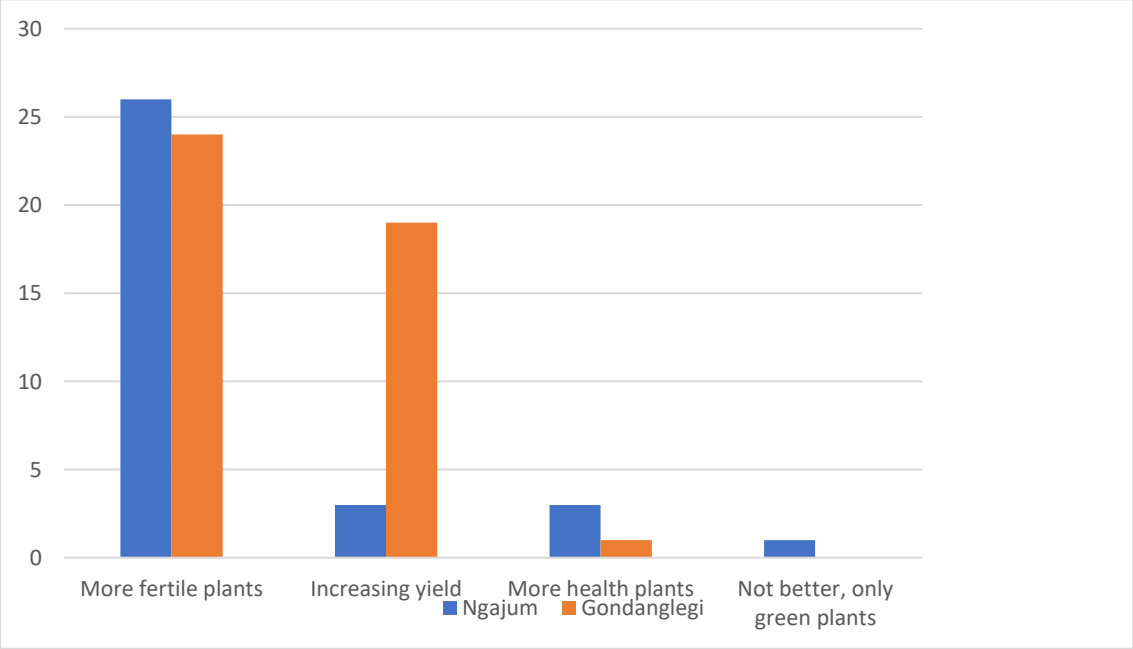
Graph 1. Farmers' knowledge and use of bio-activators in rice farming

Farmers are not always familiar with brands that are available in the market, while the brands that are known by the farmers are also not always used by them. The limitations of farmers in accessing the information on BA products marketed in several agricultural shops have caused the number of BA brands known to farmers to be limited. In addition, the marketing staff of BA products cannot reach all farmers.

Sasmito (2017) argued that the diffusion of agricultural innovations and their adoption depends on the innovative power of farmers.

Adoption of innovations should be faster if farmers receive the benefits, especially short-term benefits. Field data presented in Graph 2 illustrates the benefits perceived by rice farmers in the use of BA. The largest number of farmers stated that the benefits of using BA in rice farming are that the plants become more fertile and greener as well as grow faster. The benefits of BA in fertilizing plants are recognized with almost the same number of answers between Ngajum and Gondanglegi Districts. The next sequence of BA benefits perceived by the farmers is that BA escalates rice farming production, but the larger number in this answer is found in farmers in Gondanglegi District (Graph 2).

The third order of the benefits of BA said by farmers is that BA makes plants healthier and avoids disease. Although these answers are few among the farmers in the two sub-districts, they have the same experience. Finally, there is one answer which states that rice farmers do not get positive benefits from the use of BA in rice farming. This category of farmers answers that the use of BA does not make rice farming better than rice farming that does not use BA, yet it is recognized that the appearance of plants is greener.



Graph 2. Benefits of using bio-activators

Willingness to pay bio-activators in rice farming

Willingness to Pay (WTP) is the desire to pay the price of BA purchased by farmers. Not all farmers are willing or interested in using BA since inorganic fertilizers are considered sufficient. Besides, farmers' awareness of using BA to improve soil fertility has not been evenly distributed. Another factor is the limited purchasing power of farmers which is closely related to the economic status of farmers (Muhammad et al.,

2020), hence hampering the use of additional production facilities that are not commonly used. In addition, proof of the economic benefits of other farmers who utilize BA earlier is needed before the majority of farmers are willing to adopt BA.

Table 1. Descriptive Statistics of WTP for bio-activators

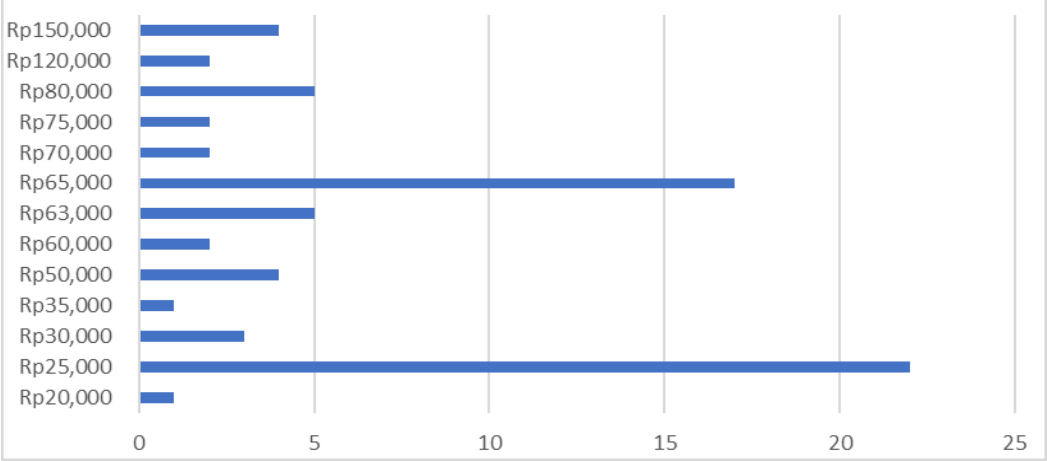
Indicator	Minimum (Rp)	Maximum (Rp)	Average (Rp)
Known BA	1	4	2.83
Land area (Ha)	0.075	3.0	0.88
Farm income (Rp)	2,000,000	40,000,000	11,628,571
Benefit of BA	1	3	2.30
Farm income (Rp)	2,000,000	40,000,000	11,628,571
WTP of BA (Rp)	20,000	150,000	56,643

Table 1 presents descriptive statistics on indicators of the number of BA known to farmers, area of farmland, benefits of BA, farm income per season, and WTP bio-activators. The statistical data is a complement to the description of rice farming using BA and the factors that affect the WTP BA.

Rice farmers in the study area are aware that one to four brands of BA are available in the market. These brands are presented in Graph 1. Likewise, the benefits of BA based on farmers' experience range from a score of one to three as discussed in Graph 2. Table 1 shows that the range of land area, farm income, and bio-activator WTP is quite wide between the minimum and maximum. Land area is one indicator that reflects the economic class of farmers since it affects farmers' income (Munardi & Situmorang, 2018). Furthermore, the result of previous studies stated that farm income had a positive effect on the WTP of organic fertilizers (Etim & Benson, 2016). The wide range of farming and income demonstrates that farmers have a fairly wide distribution of purchasing power, which will certainly affect WTP. In more detail, the WTP indicator is depicted in Graph 3.

Graph 3 displays data on the distribution of farmer respondents based on willingness to pay BA. The WTP bio-activators per litre in the range of Rp25,000 and Rp65,000 are the amount most chosen by farmers. A small number of farmers are willing to pay up to Rp150,000 per liter. If it is explored from the identity of the respondents, farmers who have a large WTP are those who have a much higher farm income than other farmers in the research area. This is in line with Etim & Benson (2016) who claimed that WTP is closely related to consumer purchasing power, in this case, farmers are consumers of BA that are used as farm inputs.

WTP information is important in the marketing of products that are environmentally friendly or oriented towards environmental improvement. Moreover, BA products also function in improving soil physical properties and maintaining soil fertility. The results of linear regression analysis showed that the two independent variables analyzed had a significant effect on the WTP bio-activators.



Graph 3. Distribution of farmers based on WTP bio-activator

Table 2 presents the results of the regression analysis. The accuracy of the model is indicated by the coefficient of determination (R^2) of 0.556, meaning that the variation of the independent variable is able to explain the variation of WTP by 55.6%, while the remaining 44.4% is explained by other variables not included in the model (Gujarati, 2005). Although the value of R^2 does not reach 60%, it is considered sufficient to explain the causal relationship between the independent variable and the dependent variable. Social research often obtains an R^2 of less than 50% (Halkos & Matsiori, 2012). The regression model has also been tested from the classical assumption disorder, namely multicollinearity and heteroscedasticity, thus it is feasible to use it as an estimator of the WTP parameter.

Table 2. The regression result of factors affecting WTP

Variable	Regression coefficient	t-value	Significance
Constant	5,408.150	0.285	0.776
Land**	15,810.305	3.364	0.001
Known-BA	-3,692.098	-1.642	0.105
Benefit**	20,735.476	2.726	0.008

**Significant at error level of 1%.

Table 2 shows that the variables of land (land area) and benefits (BA benefits) have a significance value of less than 1%. This means that the area of land and the benefits of BA are significantly influential on the WTP BA at an error level of 1%. The Known-BA factor (the number of known BA brands) has a weak effect, namely at an error level of 10.5%. The tolerance limit for significance in this study is 5%, therefore, Known-BA is not decided to have a significant effect.

The area has a highly positive effect on the WTP bio-activators with a regression coefficient of 15,810.305. This means, if the rice farming area is increased by one hectare, the WTP bio-activators will increase by Rp15,810 (the Rupiah decimal is ignored). The increase in farmers' land area shows that the economic capacity is also

increasing, consequently, farmers' paying power escalates to pay for environmentally friendly agricultural innovations. Muhammad et al. (2020) stated that the ability to pay is closely related to economic status, for farmers, it is indicated by the area of land owned. The result of this study supports previous research (Etim & Benson, 2016) that farm size or land area has a positive effect on WTP organic fertilizer purchases.

Additionally, this result also supports previous research that the area of agricultural land affects the rate of innovation adoption (Akiyana et al., 2020). Likewise, the effect of income on bio-activator WTP supports several previous studies (Etim & Benson, 2016; Muhammad et al., 2020; Ningsih et al., 2019). Etim & Benson (2016) stated that the wider the land area, the more it supports the presence of new products. For farmers in the research area, BA is a new product that is recommended to be used as a complement to production facilities that are commonly used, such as NPK fertilizer. However, this result is different from Muhammad et al. (2020) ywho argued that land area has a negative effect on WTP. The difference in these results is due to the different research locations, namely this study was conducted on rice farmers in rural areas, while Muhammad et al. (2020) conducted research in urban areas.

CONCLUSION

Farmers have already known that bio-activator product is an innovation that can complement agricultural production facilities. This product is useful in improving soil fertility in the long term. However, the use of BA has not reached the majority of farmers since they have not experienced significant economic benefits, namely an increase in rice production. Another obstacle is that the willingness to pay more for BA products is still limited. Factors that have a positive effect on WTP BA are land area and the benefits of BA to increase rice farming production. The wider the agricultural land owned by the farmer and the greater the perceived benefits, the higher the WTP value will be.

RECOMMENDATION

This information can be taken into consideration for BA manufacturers as a new introduction before being released in the market. BA products can be marketed with a market penetration strategy, namely prioritizing farmers with large land and high-paying power to introduce the products so that BA adoption is faster. In addition, further research can examine in more detail by using experimental designs to introduce new BA products. The method of introducing new BA products in experiments uses the priority of a larger area.

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