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SINTA 2

Farmers' Perception for Bio-Slurry Fertilizer in Central Java

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ABSTRACT
Bio-slurry is an organic fertilizer derived from the residual waste of biogas processing. This study aims to: 1) find out farmers' perception of bio-slurry fertilizer, 2) determine the socio-economic characteristics of farmers who confirm to adopt bio-slurry fertilizer in the future. The study was conducted from January to February 2020 in Central Java. Determination of location was purposive with the consideration that farmers in Magelang and Demak Regency, who had utilized biogas waste and commercialized it. Primary data was obtained from 80 by accidental sampling. Data analysis used the attributes of innovation: relative advantage, compatibility, complexity, trialability, and observability to measure farmers' perceptions and cross tabs to determine the distribution of confirmation to adopting/stop adopting bio-slurry fertilizers. The results showed that farmers' perceptions of the relative advantage and trialability of bio-slurry fertilizer were moderately satisfied, completely satisfied perceptions of compatibility, very satisfied with the complexity, and observability of using bio-slurry fertilizers. Respondents who confirmed to adopt bio-slurry fertilizer had characteristics: 1) income of around IDR 2,100,000-3,000,000/month and >Rp. 5,000,000/month; 2) have a high school level education; 3) have land ownership area <0.5 ha; 4) have an age between 41-50 years, and 5) have 3-4 family members. Farmer satisfaction level indicates the good opportunity to survive in the market by taking into account quality.

Keywords: Bio-slurry Fertilizer, Adoption of Innovations, Attributes of Innovations.

INTRODUCTION
Livestock waste in large quantities has the potential to pollute the environment and harm the community. The utilization of livestock manure as alternative energy in the form of a biodigester capable of producing biogas. A biodigester is a tool that functions to ferment livestock manure into biogas, the remaining waste from biogas production in the form of bio-slurry can be used as organic fertilizer for agricultural land (Adityawarman, 2015). Tim Biru & Yayasan Rumah Energi (2013), stated that bio-slurry could be produced in several products such as organic fertilizers, pesticides, feed ingredients, and plant cultivation media.

Bio-slurry fertilizer has advantages over agricultural waste compost, such as higher total N content, ammonium, and pH, as well as the C/N ratio, decreased from 10.7 to 7 whose means it has good quality (Insam et al., 2015). The utilization of bio-slurry into organic fertilizer can increase land productivity and improve environmental quality (Massah & Azadegan, 2016; Savci, 2012). In addition, consumer awareness of the quality of organic agricultural products

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on health makes the price of organic agriculture products more expensive than conventional agriculture products (McFadden & Huffman, 2017). This condition causes farmers to switch from non-organic to organic fertilizers.

The utilization of biogas waste has not been carried out optimally because bio-slurry is an innovation among farmers so they do not know the benefits of bio-slurry fertilizer for agricultural land. This causes farmers to be reluctant to adopt the use of bio-slurry fertilizers for their agricultural land. Roger (2003), defines innovation as an idea or practice that is considered new by individuals. He also stated that the individual's perception of the attributes of innovation determines the adoption process. If bio-slurry fertilizer has advantages over organic fertilizers, it would be adopted by farmers and otherwise. Adoption is a process in decision-making (Roger, 2003). Farmers will go through a stage where knowledge of bio-slurry fertilizer will build a positive or negative perception of the innovation. According to Roger (2003), the process of building positive or negative perceptions was influenced by five characteristics of innovation, namely relative advantage, compatibility, complexity, trialability, and observability.

Adoption decision-making is a mental process within the individual after starting to recognize an innovation until finally deciding to accept or reject the innovation. Suhendrik et al. (2013), stated that an individual's decision to adopt or implement innovation was affected by perception. Previous research has shown that the adoption of innovations by farmers reflects rational decision-making based on perceptions of the suitability of the characteristics and value of innovation (Caffaro et al., 2020; D'Antoni et al., 2012). Besides, Farmers' socio-economic factors such as education, income, and age also influence adoption decisions (Mohammed et al., 2020; Nabinta & Muntaka, 2015) especially in sub-Saharan Africa. Poor soil fertility is among the major abiotic factors that contribute to this crop's low yield. Phosphorus (P.

This research is interesting to study considering that most livestock waste in practice is only used for biogas, then the biogas waste will be disposed of and not used. This also happened in Central Java where the utilization of biogas waste as a by-product with economic value had not been fully implemented, only a few farmer groups and livestock in Magelang and Demak Regencies had utilized biogas waste so that it had economic value. Biogas waste that can be processed into organic fertilizer (bio-slurry fertilizer) is a new innovation, especially among farmers and ranchers. Generally, farmers do not have knowledge about the characteristics and benefits of bio-slurry fertilizer, so they may not want to adopt the innovation. Therefore, this study was conducted to determine farmers' perceptions of the use of bio-slurry fertilizers for agricultural land.

METHODOLOGY

The study was conducted from January to February 2020. The research location was determined purposively by considering that the Regencies of Magelang and Demak have five farmer groups and livestock that have utilized biogas waste into organic fertilizer and had been commercialized, based on information from the Department of Agriculture and Plantation of Central Java Province. The farmer and livestock groups are Jati Sari and Sido Mulyo farmer and livestock groups in Salam District, Sumber Sari farmer and livestock Group in Ngablak District, Sido Mukti, and Makmur Farmers Group and Livestock in Karangawen District. In this study, the population of farmers who use bio-slurry fertilizer is unknown, so the sampling technique uses accidental sampling which is carried out around livestock farmer groups that have commercialized bio-slurry fertilizer. The sample in this study amounted to 80 respondents by each district had taken 40 respondents as a sample.

Objective 1, farmers' perceptions of the characteristics of bio-slurry fertilizer

were analyzed using several variables such as relative advantage, compatibility, complexity, trialability, and observability. Furthermore, each of these variables will be measured according to the indicators and criteria as shown in table 1, then the criteria are scored using a Likert scale. Meanwhile, to analyze objective 2 namely the confirmations distribution to continue adopting/stop adopting bio-slurry fertilizer, it was analyzed using cross tabs with SPSS 21 software.

RESULTS AND DISCUSSION

Respondents in this study were farmers who had purchased and have used bio-slurry fertilizer for their agricultural land. The research conducted shows that farmers who use bio-slurry fertilizers are farmers of horticultural and food crops. The cultivated plants are rice, potatoes, corn, chili, shallots, long beans, cabbage, tomatoes, mustard greens, spinach, carrots, beans, lettuce, beets, melons, and watermelons. The characteristics of farmers using bio-slurry fertilizers in Central Java, based on table 2, were that most of the respondents are 41-50 years old (37.50%), indicating that the respondents are still in their productive age. Nabinta & Muntaka (2015), stated that at productive age, farmers were considered more active. Especially the tendency to adopt innovations and new ideas, as well as are more willing to take risks. The majority of respondents had a minimum education of high school graduates (28.75%). Farmers who have higher education tend to be open to new technologies or

Table 1
Indicator of Farmer Perception Level

Variabel	Indicator
Relative Advantage	Economic
	Prestige
Compatibility	Compatibility of bio-slurry fertilizer with environmental conditions
	Compatibility of bio-slurry fertilizer with farmers' values and beliefs
	Compatibility of bio-slurry fertilizer with farmers' habits in fertilizing
	Compatibility of bio-slurry fertilizer with farmers' needs and expectations
Complexity	Application complexity
	Difficulty in obtaining supporting facilities for bio-slurry fertilizer
Trialability	According to purchasing ability
	Easy to apply Individually
Observability	Production such as the results obtained after using bio-slurry fertilizer
	Quality eaves become wide, green and fresh, plant stems are stronger and manage to loosen the soil)

Source: Primary Data Processed, 2020

Table 2
Interpretation Scale Range

Response Range Criteria	Scale Range
Not at all satisfied	1.00 – 1.79
Slightly Satisfied	1.80 – 2.59
Moderately Satisfied	2.60 – 3.39
Very Satisfied	3.40 – 4.19
Completely Satisfied	4.20 – 5.00

Source: Syikhristani, 2018.

innovations, which would have an impact on increasing farm production. This is like the opinion expressed by Mignouna et al. (2011), that the higher the education of farmers, the ability to obtain and process information will be better so that the adoption process occurs more quickly. In this study, the number of family members was smaller than the national family size programmed by the government, namely four people. Meanwhile, the average number of respondents' family members was two people (51.25%). The majority of respondents had income levels of IDR 1,000,000-3,000,000 (48.75%) and land ownership area <0.5 ha (68.75%).

Farmers Perception of Bio-slurry Fertilizer

Asnamawati (2015) and Noppers et al. (2016), stated that relative advantage has a considerable influence on innovation adoption. This is because the benefits from innovation are the first things that farmers consider in adopting innovations. The results of the field research show that

Tabel 3
The Characteristics of Respondents

No.	Description	Percentage (%)
1.	Age (years)	
	- 30-40	10.00
	- 41-50	37.50
	- 51-60	31.25
	- >61	21.25
2.	Education	
	- Not an Elementary Graduate	21.25
	- Elementary School	23.75
	- Junior High School	23.75
	- Senior High School	28.75
	- Undergraduate	2.50
3.	Family size (people)	
	- ≤2	51.50
	- 3-4	42.50
	- 5-6	6.25
4.	Land ownership (ha)	
	- <0,50	68,75
	- 0,50-1	27,50
	- >1	3,75
5.	Income (IDR)	
	- < 1,000,000	13.75
	- 1,000,000 – 3,000,000	48.75
	- > 3,000,000	37.50
6.	Cultivator commodity	
	- Food crops	28.75
	- Holticultural	53.75
	- Food crops and holticultural	17.50

Source: Primary Data Processed, 2020.

the relative advantage of using bio-slurry fertilizer was in the moderately satisfied category. This condition was indicated by the fact in the field that the costs incurred by farmers for bio-slurry fertilizers are relatively cheaper than factory chemical fertilizers and other organic fertilizers. The price of bio-slurry fertilizer ranges from IDR 520–1,000/kg. Farmers who have used bio-slurry fertilizer for approximately 1.5 years will experience an increase in income, especially horticultural farmers. This is because bio-slurry fertilizers in horticultural crops are effective in preventing diseases such as clubroot in cabbage and mustard plants so that indirectly the production costs for purchasing fungicides would be reduced and the risk for crop failure due to disease attacks is smaller so income will increase.

Farmers' perceptions of the compatibility of bio-slurry fertilizers were in the completely satisfied category. Bio-slurry fertilizer comes from biogas waste which is processed into organic fertilizer so that not pollute the environment. The use of bio-slurry fertilizer is convenient with social values in a society like being environmentally friendly and believed to create healthy food products. The reason for using bio-slurry fertilizer by farmers was fertility problems and cheaper prices. In this study, farmers stated that it was hard to use bio-slurry fertilizer without being combined with other fertilizers. For example, rice farmers use bio-slurry fertilizer to fertilize the soil, and NPK/Urea fertilizer to increase crop yields. Under these conditions, farmers' perception of bio-slurry fertilizers is very good on the suitability according to their expectations and needs. This is like the opinion of Adnan et al. (2019), also to increase the production level among all the agriculture crops. It is especially needed for paddy production, as it has always been considered as an important commodity because it is the main staple food for the nation. Paddy production in Malaysia using GFT allows for sustainable development and boosts the yield. Nevertheless, the adoption rate of GFT is unsatisfactory in most of the developing countries, including in Malaysia. The fact that the cost of production is considerably higher results in low-level perception regarding the adoption of GFT. Hence, the integration of communication and technology factors could become one of the main elements for the further development of the paddy sector in Malaysia. The overall objective of this research study will identify the factors that determine paddy farmer's adoption decision on GFT in Malaysia. To do so, a literature review was compiled on the topic of agriculture innovation-based adoption decision theories such as Diffusion of innovation (DOI) and that the suitability of innovation to habits, experiences, and social values in society affects the level of adoption of these innovations (Hendrawati et al., 2014).

The majority of respondents (57.50%) stated that the complexity of using bio-slurry fertilizer is in the very satisfied category. This means that the application of bio-slurry fertilizer is not difficult and simple to do. Bio-slurry fertilizer can be applied directly to the land. For farmers of food crops such as rice and corn, bio-slurry fertilizer is used for basic fertilizer. Whereas for horticultural farmers, bio-slurry fertilizer is not only used as basic fertilizer but also secondary fertilizer so that fertilization will be applied twice per growing season. The first fertilization is carried out as a basis during the land processing stage, then the second fertilization is carried out during the early growth phase of the plant. Fertilization at the early growth stage is done by combining it with other fertilizers such as rabbit liquid fertilizer, NPK fertilizer, or ZA fertilizer. The facilities needed to use bio-slurry fertilizer are also simple and not much, such as using a hoe and a bucket to be applied in the field. The ease of a technology/innovation is an adopter priority in adopting innovation (Asnamawati, 2015; Trischler et al., 2020; Warnaen et al., 2013).

The convenience of technology/innovation to try is the most necessary variable in the adoption process (Aubert et al., 2012; Hermawati et al., 2016). In this study,

the level of convenience of using bio-slurry fertilizer to try was moderately satisfied. On average, bio-slurry fertilizer is sold in sacks (25-30 kg). As for the instructions for use, farmers who are buying for the first time will be given instructions and directions for bio-slurry fertilizer using by producers. The use of bio-slurry fertilizers varies depending on the needs of the plant or the wishes of the farmers themselves. In rice, farmers generally use bio-slurry fertilizer about 30-50 kg per 1000 m^2 with a combination of other fertilizers. Meanwhile, for horticultural farmers such as onion farmers, bio-slurry fertilizer is used at around 30 kg per 1000 m^2 and is combined with inorganic fertilizers such as NPK fertilizer.

The observability of bio-slurry fertilizer for agricultural land was in the very satisfied category. Some farmers who have used bio-slurry fertilizer for approximately 1-2 years regularly stated that there was an increase in the added value of production which was indicated by changes while greener, fresher, and wider plant leaves and stems that looked firm. In horticultural crops, increasing production value could be seen from the results of vegetables were more durable in storage compared to using chemical fertilizers, and the gradual increase in seasonal production because they are free from disease attacks. In rice plants using bio-slurry fertilizer regularly for at least two years, there will be an increase in rice production of approximately 1-2 quintals per hectare, besides the use of bio-slurry fertilizer makes the rice produced more durable when it is cooked and also does not rot easily. it tastes fluffier and tastier. The use of bio-slurry fertilizer regularly will also provide benefits, namely looser soil. Insam et al. (2015), stated that organic fertilizer from biogas waste contains higher total N, ammonium, and pH than composted agricultural waste, while the C/N ratio decreased from 10.7 to 7 so it has good quality. In addition, biogas waste is a source of N with a low risk of N loss, and the microbial activity occurring after the application of biogas waste has contributed to an increase in the availability of C and other nutrients (Frąc et al., 2012). Therefore after the application of bio-slurry fertilizer, the soil will be quite fertile and will provide good benefits to plants such as greener leaves and stronger.

Distribution of Confirmation to Continue/Stop Adopting Bio-slurry Fertilizer Based on Respondents' Socio-Economic Characteristics

In this study, income plays a significant role in farmers' decision to adopt or stop adopting bio-slurry fertilizers. Farmers who have low incomes will tend to delay or even

Tabel 4
Percentage of Farmers Perception of Bio-slurry Fertilizer

Category	Persentase (%)				
	Relative Advantage	Compatibility	Complexity	Trialability	Observability
Not at All Satisfied	-	-	-	2.50	-
Slightly Satisfied	25.00	-	-	16.25	5.00
Moderately Satisfied	42.50	11.25	5.00	50.00	25.00
Very Satisfied	22.50	42.50	57.50	26.25	40.00
Completely Satisfied	10.00	46.25	37.50	5.00	30.00
Total	100.00	100.00	100.00	100.00	100.00

Source: Primary Data Processed, 2020

reject innovations if the innovation is quite expensive. Net income is the main factor in adoption because the higher the income, the higher the investment opportunities for innovations/technology, with the hope that the new technology can increase their income. (Baffoe-Asare, 2013; Rodríguez-Entrena & Arriaza, 2013).

Table 3 shows that the higher the level of formal education completed, the lower the chance to stop adopting bio-slurry fertilizer. Likewise, the response to continuing to receive bio-slurry fertilizers is increasing along with the increase in the level of education taken, except for those with higher education degrees which have decreased, because the number of respondents who graduated from universities in this study were very few, namely three people. Akudugu et al. (2012), categorize the determinants of agricultural technology adoption, namely economic, social and institutional, or institutional factors, where education is included in social factors that determine adoption decisions. Mwangi & Kariuki (2015), economic, institutional factors and human specific factors are found to be the determinants of agricultural technology adoption. The study recommend the future studies on adoption to widen the range of variables used by including perception of farmers towards new technology. Introduction Agriculture plays an important role in economic growth, enhancing food security, poverty reduction and rural development. It is the main source of income for around 2.5 billion people in the developing world (FAO, 2003 also stated that education indirectly influences the decision to adopt. An individual's ability to receive information about an innovation depends on the level of education, if the individual can receive and digest information well then the opportunity to adopt is also great.

According to economic factors, land ownership is considered one of the most important factors of technology adoption. Many studies have reported a positive relationship between farm size or land ownership and adoption of innovation/ technology (Lavison, 2014; Mignouna et al., 2011). However, the results of this study are different from several previous studies, where the more agricultural land, the lower the response to adopting it. This is because a large area requires more capital, so farmers use more chemical fertilizers, which produce much more output than organic fertilizers. In addition, most of the respondents (56 farmers) in this study owned land <0.5 ha, so the response to accept or reject adoption was dominated by respondents with land ownership <0.5 ha.

Table 3 shows that 61.25% of respondents in this study confirmed that they still adopt bio-slurry fertilizer, where most of the respondents are between 41-50 years old. Age is an influential factor in the adoption of bio-slurry fertilizer. The older their age, the slower the adoption of innovations because the older farmers are less open to innovations (Roussy et al., 2017). Kariyasa & Dewi (2013), also stated that older farmers have more experience and knowledge than younger farmers, so they think more about the long-term risks of innovation.

The number of family members affects the technology adoption process (Challa & Tilahun, 2014). The size of family members shows the number of family members must be borne by the head of the family, so the more the number of family members, the greater the expenditure to meet basic daily needs. Therefore, the more the number of family members, the chances of adopting innovative technology will tend to below. Table 3 shows that the more family members, the greater the response to refusing to use bio-slurry fertilizer, example if the number of family members is 5-6 people, the opportunity to stop innovation is greater, namely 6.25% compared to the number who accept, namely 1.25%. Research conducted by Mignouna et al. (2011), differs from most theories which state that the number of family members will have a negative effect on innovation adoption decisions.

The more family members, the more labor needs are needed so that the process of adopting new technology can be met by the workforce in the family.

CONCLUSION

Analysis of farmers' perceptions shows that farmers' perceptions of bio-slurry fertilizers are very satisfied. It's indicated that bio-slurry fertilizer as expected and needed by farmers. Starting in terms of economy, environmental conditions, values and beliefs, habits, production, and quality. The level of farmer satisfaction with the use of bio-slurry fertilizer for agricultural land shows that bio-slurry fertilizer has the competitiveness to survive in the market. But also must be balanced with quality improvement. Meanwhile, respondents who confirmed that they would continue to use bio-slurry fertilizer had characteristics such as having a high income, a minimum education level of high school, a land ownership area of <0.5 ha; a productive age, and having a family of 3-4 people. Manufacturers need to pay attention to the quality of bio-slurry fertilizer products. Product size development according to farmers' purchasing power needs to be carried out by producers considering that bio-slurry fertilizer is only available in sacks (25-30kg). In addition, packaging development is needed, such as adding instructions for use and nutritional content in bio-slurry fertilizer packaging to attract more consumers' attention. The need for increased knowledge and insight by producers in the manufacture of bio-slurry fertilizers, because most producers dry bio-slurries in direct sunlight so that the effective nitrogen (N) content would be lost.

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Appendix 1. Distribution of Confirmation to Continue/Stop Adopting Bio-slurry Fertilizer

No.	Description	Percentage (%)		
		Keep receiving	Stop receiving	Total
1.	Income (IDR)			
	- < 1,000,000	6.25	7.50	13.75
	- 1,000,000 – 2,000,000	12.50	12.50	25.00
	- 2,100,000 – 3,000,000	15.00	8.75	23.75
	- 3,100,000 – 4,000,000	6.25	5.00	11.25
	- 4,100,000 – 5,000,000	6.25	2.50	8.75
	- > 5,000,000	15.00	2.50	17.50
	Total	61.25	7.50	100.00
2.	Education			
	- Not an Elementary Graduate	7.50	13.75	21.25
	- Elementary School	15.00	11.25	26.25
	- Junior High School	16.25	7.50	23.75
	- Senior High School	18.75	6.25	25.00
	- Undergraduate	3.75	0.00	3.75
	Total	61.25	38.75	100.00
3.	Land ownership (ha)			
	- <0,50	36.25	33.75	70.00
	- 0,50-1	22.50	3.75	26.25
	- >1	2.50	1.25	3.75
	Total	61.25	38.75	100.00
4.	Age (years)			
	- 30-40	6.25	3.75	10.00
	- 41-50	25.00	12.50	37.50
	- 51-60	18.75	15.00	33.75
	- >61	11.25	7.50	18.75
	Total	61.25	38.75	100.00
5.	Family size (people)			
	- ≤2	28.75	21.25	50.00
	- 3-4	31.25	11.25	42.50
	- 5-6	1.25	6.25	7.50
	Total	61.25	38.75	100.00

Source: Primary Data Processed, 2020