

Farmers' Willingness to Pay for Bio-Slurry Fertilizer

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ABSTRACT

Bio-slurry is the residual product of biogas processing waste through the decomposition process without oxygen (anaerobic). Bio-slurry can be used as organic fertilizer for agricultural land. This study aims to: 1) assess the value of willingness to pay (WTP) for bio-slurry fertilizer, 2) find factors affecting farmer's willingness to pay (WTP) of bio-slurry fertilizer. The research was carried out from January to February 2020 in Central Java. Determination of the location was purposive based on the farmers in Magelang and Demak Regency that have utilized biogas waste to be organic fertilizer and had been commercialized. Primary data were obtained from 80 farmers using purposive sampling, with the aid of questionnaire. Data analysis using contingent value method (CVM) to evaluate the farmer's willingness to pay and logistic regression to analyze its determinant factors. The result showed that farmer's willingness to pay (WTP) rate of bio-slurry fertilizer was IDR. 937,5/kg, which was above the market price. The determinant factors were farm income, education, price, and experience using organic fertilizer positively related to farmers' willingness to pay bio-slurry fertilizer whereas land area negatively related to farmers' willingness to pay bio-slurry fertilizer. The value of willingness to pay showed the opportunity for bio-slurry fertilizer to survive in market by taking into account continuity of production and quality.

Keywords : Bio-slurry Fertilizer, Contingent Valuation Method, Willingness to Pay

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INTRODUCTION

An increase of livestock businesses creates negative externalities in the form of livestock waste. Livestock manure can be used as alternative energy in the form of biodigester that can produce biogas. A biodigester is a tool that has a function to ferment

livestock waste into biogas, the remaining waste from biogas production in the form of bio-slurry that can be processed into various products (Adityawarman et al., 2015). Tim Biru & Yayasan Rumah Energi (2016) stated that biogas or bio-slurry waste could be utilized as organic fertilizer, pesticides,

feed ingredients, and even be used as plant cultivation media.

Utilization of bio-slurry into organic fertilizer can reduce the use of non-organic fertilizer which causes a decrease in land productivity and environmental quality (Savci, 2012; Mass & Azadegan, 2016). This is because bio-slurry fertilizer has the advantage such as the total N content, ammonium, and pH are higher than composted agricultural waste, while the C/N ratio decreased from 10.7 to 7 which means it has good quality (Insam et al., 2015). Besides, consumer awareness of the benefits of organic products makes consumers be willing to pay for organic agricultural products at a prices more expensive than conventional agricultural products (McFadden & Huffman, 2017). This condition leads farmers to shift from non-organic fertilizer to organic fertilizer.

The willingness of farmers to pay for bio-slurry fertilizer is influenced by the socio-economic characteristics of farmers. Previous studies had shown that consumers' willingness to pay for compost fertilizer will increase if consumer incomes are high, consumer education levels were high and farm size is large (Kowornu et al., 2017; Zhou et al., 2018). Conversely, if age increases, the price is higher and the number of family members increasing, then the willingness of consumers to pay for compost is lower (Etim & Benso, 2016; Danso et al., 2017). According to Oti Agyekum et al. (2014), the experience of using organic fertilizers would also affect the willingness to pay for fertilizer from faecal waste re-use. Willingness to pay shows the economic value of an

item that serves to get a specific picture of quality and utility.

Many studies have investigated willingness to pay using logistic regression to analyze socio-economic factors that influence on WTP. Research conducted by Oti Agyekum et al., (2014) used logistic regression to analyze the factors affecting farmer's willingness to pay for compost, and research conducted by Cheng et al., (2015) used logistic regression to analyze factors affecting milk safety demand. Logistic regression models have advantages when compared linear regression such as offense of the assumption of normality and homoscedasticity so mathematically using logit regression is easier to use (Hosmer et al., 2013).

The demand for bio-slurry fertilizer in the Central Java market is an interesting issue to learn, considering that bio-slurry fertilizer only comes from biogas waste which is generally not utilized. Farmers' willingness to pay for bio-slurry fertilizer whether it is above or below the average market price offered and how socio-economic characteristics affect the willingness to pay for bio-slurry fertilizer in this study will provide information about the potential sales and market segmentation of the bio-slurry fertilizer market. The novelty in this study is that there is no research on farmers' willingness to pay for bio-slurry fertilizer and its determinant factors in Central Java Province.

METHODS

The research was conducted in Central java between January, 2020 and February, 2020 using the purposive

sampling. Based on information from Dinas Pertanian dan Perkebunan Provinsi Jawa Tengah that Magelang and Demak Regencies have five farmers groups and livestock that have utilized biogas waste to be organic fertilizer and had been commercialized. The five farmer groups and livestock chosen were Jati Sari and Sido Mulyo farmer groups and livestock in Salam district, Sumber Sari farmer groups and livestock in Ngablak district, Sido Mukti and Makmur farmer groups and livestock in Karangawen district.

Purposive sampling was applied with consideration of farmers who had bought and used bio-slurry fertilizer for their agricultural land. The sample in this study was obtained based on information from bio-slurry fertilizer producers, farmers who often buy the fertilizer they sell, so the population in this study was unknown in number. Determination of the number of samples according to the opinion of Sugiyono (2015) that in research with multivariate analysis, the number of sample members is at least 10 times the number of variables studied so that the samples in this study were 80 respondents with each district had 40 respondents.

Obtaining bids of WTP Value

Closed referendum method (dichotomous choice) was used to obtain the bid value. It was done by offering the respondent an amount of money then asking whether the respondent wants to pay or not the amount of money to obtain benefits from the use of bio-slurry fertilizer.

Calculate an estimate of average value of WTP

The average value of WTP was obtained from the sum of all WTP values divided by the number of respondents. The average value of WTP was calculated using this EWTP formula (Fauzi, 2010):

$$E WTP = \sum_{i=1}^n W_i (f_i)$$

where :

EWTP = Alleged value the average WTP of the respondents

W_i = WTP value of the respondent-i (IDR)

f_i = The relative frequency WTP of respondents-i

n = Number of respondents

i = The i-respondent who is willing pay ($i=1,2,\dots,80$)

Estimating the value curve of WTP

WTP curves were obtained by grouping WTP values with independent variables as in the following equation:

$$WTP = f (X_1, X_2, X_3, X_4, X_5, X_6, X_8)$$

where :

WTP = Value of WTP respondent

X_1-X_8 = Independent Variable (income, land area, education, age, number of family dependents, price of bio-slurry fertilizer, experience using organic fertilizer other than bio-slurry fertilizer and area/location).

Aggregating data

Calculation of aggregation of total WTP data was obtained from the average value of WTP converted to population. Calculation of total WTP

could be calculated by this formula (Fauzi, 2010):

$$TWTP = EWTP \times P$$

where :

TWTP = Total value of WTP (Rp)

EWTP = Estimated value of the average WTP of respondent

P = Population (people)

Evaluation

Evaluation was used to determine the extent to which the price paid by farmers is in line with the perceived benefits.

Factors affecting the WTP of farmers using bio-slurry fertilizer in Central Java were analyzed by using logistic regression with Eviews 9 software. Logistic regression was used to determine the probability of independent variables in the model, besides the data in this study was not pass the normality and heteroscedasticity test, so this study used logistic regression to find factors affecting farmer's willingness to pay (WTP) of bio-slurry fertilizer. The logistic regression analysis model used in this study as follows:

$$\ln \left[\frac{P}{1-P} \right] = \beta_0 + \beta_1(INC) + \beta_2(AREA) + \beta_3(EDC) + \beta_4(AGE) + \beta_5(FMLY) + \beta_6(PRC) + \beta_7(D_EXP) + \beta_8(D_LOC) + e$$

where :

P = Probability of farmers willing to pay for more than average WTP values bio-slurry fertilizer in Central Java

1-P = Probability of farmers to pay bio-slurry fertilizer is less than the value of average

WTP bio-slurry fertilizer in Central Java

INC = Income (IDR/month)

AREA = Land Area (m²)

EDC = Education (years)

AGE = Age (years)

FMLY = Family size (people)

PRC = price of bio-slurry fertilizer (IDR/kg)

D_EXP = experience using organic fertilizer (1= with experience in organic fertilizer other than bio-slurry fertilizer, 0= with no experience in organic fertilizer)

D_LOC = area/location (1= Demak, 0= Magelang)

RESULTS AND DISCUSSION

Respondents in this study were farmers using bio-slurry fertilizer in Central Java. Based on research conducted, it can be seen that farmer using bio-slurry fertilizer were those clanting horticultural and food crops such as rice, corn, shallots, chilies, cabbage, potatoes, tomatoes, mustard greens, chinese cabbage, carrots, lettuce, beat fruit, spinach, long beans, melons, watermelons, and beans. Tabel 1 shown that farmers using bio-slurry fertilizer in Central Java had characteristics such as the age of respondents was about 41-50 years (37.50%), suggesting that the respondents were still in their fairly active and productive age. The majority of respondents were high school graduates at education level (28.75%), indicating that the respondents had at least primary education from the government's compulsory education program.

The mean of family size was ≤ 2 people (51.25%). It implies that the

family size in this study was smaller than the national family size recommended by the government which is 4 people. The majority of the respondents had income levels of IDR. 1,000,000-3,000,000 (48.75%) and area of land ownership < 0.5 ha (68.75%). The area of land ownership was a major factor in the farm production process, which will affect the income generated. The more extensive the land, the greater the products are produced, moreover the income will increase (Ambarita & Kartika, 2015).

Value of WTP Respondent of Bio-slurry Fertilizer in Central Java

Based on research that has been done, it was found that 58.75% of respondents were willing to pay bio-slurry fertilizer equivalent or above the market price and 41.25% of respondents were only willing to pay below the market price (table 2). Farmers' willingness to pay for bio-slurry fertilizers above-market prices in this study was based on environmental awareness, farmers' beliefs, and knowledge that bio-slurry fertilizers were organic fertilizers bringing many benefits compared to chemical fertilizers. Both tangible benefits such as increased production and intangible benefits such as more fertile land.

Value of WTP

Based on research conducted, the lowest WTP value that farmers using bio-slurry fertilizer are willing to pay was IDR 400/kg, while the highest value reached IDR 3,000/kg. The number of respondents who were willing to pay a certain amount of bio-slurry would be

even bit parallel with the addition of the WTP value. It is shown by the table 2 and curve in figure 1, that the higher the level of WTP, the fewer the respondents were willing to pay for bio-slurry fertilizer.

Respondents chose to pay bio-slurry fertilizer lower than market prices (IDR. 400-600/kg) because they were not being able to pay if the price of bio-slurry fertilizer was higher, and some respondents thought that the benefits of using bio-slurry fertilizer for agricultural land could not be immediately experienced. It required sufficient time depending on the level of soil fertility used. Besides, respondents in this study stated that processing bio-slurry fertilizer did not require high costs because it was generated from livestock waste so that it should be cheaper. Respondents who were willing to pay bio-slurry fertilizer at the highest price were chili farmers. They were willing to pay bio-slurry fertilizer at a high price. It was because bio-slurry fertilizer was proven to be able to prevent anthracnose caused by fungi.

Average value of WTP

The average value of WTP bio-slurry fertilizer in Central Java was IDR 937.5/kg (table 2). It was higher than the average price of bio-slurry fertilizer in Central Java (IDR 700/kg). It indicates a consumer surplus of IDR 237.5/kg, meaning that bio-slurry fertilizer has bigger selling power which furthermore open more opportunities to survive in Central Java market. One of the aspects that should be maintained in order bio-slurry fertilizer able to survive in the market beside price was quality.

Bio-slurry fertilizer contains enough nutrients needed by plants. To keep the nutrients from being lost during the fermentation process in the digester, it is necessary to have enough knowledge to produce fertilizers with good quality. In addition to quality, the sustainability of production is also the key to staying on the market. The facts on the field show that in Magelang Regency especially in Ngablak district, bio-slurry fertilizer was difficult to obtain during the rainy season. It was because Ngablak district is located at the foot of Mount Merbabu. During the rainy season there was almost no sun heat. It became obstacle for producers as in the process of making bio-slurry fertilizer, solar heat is essential for the drying process.

Factors Which Affected Consumer WTP Value of Bio-slurry Fertilizer in Central Java

Determinants of farmer's willingness to pay were analyzed by using binary logit regression. The level of willingness to pay farmers (WTP) bio-slurry fertilizer was divided into two levels, namely probability of farmers would be willing to pay more than average the WTP values and to pay less than the value of average WTP bio-slurry fertilizer in Central Java.

The average value WTP of bio-slurry fertilizer in Central Java using CVM analysis results was IDR 937.5/kg. If farmers are willing to pay bio-slurry fertilizer \geq IDR 937.5/kg then the WTP

Table 1. 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

Source: Primary Data (2020)

Table 2. Percentage of WTP Respondents Bio-slurry Fertilizer

WTP (IDR/Kg)	Frequency	Percentage (%)	Relative frequency	Avarage Value of WTP (IDR/Kg)
400	8	10.00	0.1000	40.00
500	24	30.00	0.3000	150.00
600	1	1.25	0.0125	7.50
700	5	6.25	0.0625	43.75
800	9	11.25	0.1125	90.00
900	1	1.25	0.0125	11.25
1,000	11	13.75	0.1375	137.50
1,400	4	5.00	0.0500	70.00
1,500	12	15.00	0.1500	225.00
2,000	2	2.50	0.0250	50.00
3,000	3	3.75	0.0375	112.50
Total	80	100.00	1	937.50
Population				34,490,835
Total Aggregation				32,335,157,813

Source: Primary Data (2020)

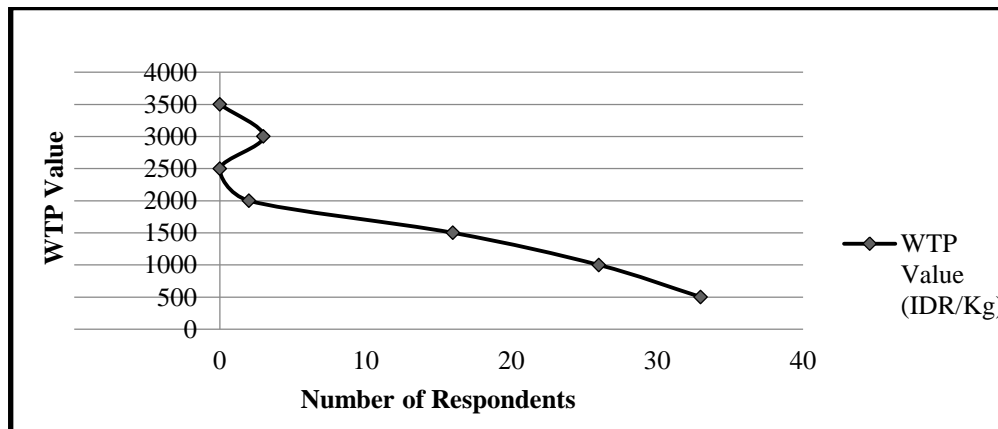


Figure 1. Bio-slurry Fertilizer WTP curve in Central Java

Source: Primary Data (2020)

will be worth 1, and on the contrary, if farmers are willing to pay bio-slurry fertilizer < IDR 937.5/kg the WTP will be worth 0.

Income

Low income farmers in this study did not want to pay for bio-slurry fertilizer due to the limited income. They preferred the bio-slurry fertilizer derived from livestock waste that it did not require a lot of costs to produce. While farmers with high income did not consider price for bio-slurry fertilizer

but more on the harvest increase from the use of this fertilizer. Thus, they were willing to pay more for bio-slurry fertilizer.

The higher the income, the greater the ability to pay for goods or services (Velčovská & Del Chiappa, 2015). In this study, income had a

positive effect on the willingness to pay for bio-slurry fertilizer. It is

Table 2. Logistic Regression Analysis For Determinant Factors of Farmers' Willingness to Pay Bio-slurry Fertilizer

Variable	Expected sign	Coefficient	Odds Ratio	z-statistics
Constanta		-18.8520 ***	6.4965	-2.7959
Income	+	1.6000 ***	4.9530	2.8669
Land Area	+	-0.0006 **	0.9994	-2.3882
Education	+	0.3492 **	1.4179	2.2327
Age	-	-0.0176 ^{ns}	0.9826	-0.2322
Family Size	-	-0.0621 ^{ns}	0.9398	-0.1460
Price of Bio-slurry Fertilizer	-	0.0181 ***	1.0183	3.1907
Experience Using Organic Fertilizer	+	3.5138 ***	33.5756	2.8579
Area/Location	+	-1.3072 ^{ns}	0.2706	-1.2275
Mc Fadden R ²				0.6155
LR Statistik				66.2822
Prob (LR Statistik)				0.0000
H-L statistik				14.4882
Prob (H-L statistik)				0.0699

Notes :

*) Significant at the level 90%

**) Significant at the level 95%

***) Significant at the level 99%

Source: Primary Data (2020)

consistent with the previous research conducted by Zhou et al., (2018) showing that income had a positive effect on willingness to pay for vegetable residue compost in North China. Research conducted by Karisyawati et al., (2019) also revealed that income had a positive effect on consumers' willingness to pay for Cavendish bananas in the Special Region of Yogyakarta.

Land Area

The results of this study was contradictive to the previous research explaining that farm size such as land area, pond area, and the number of livestock had a positive effect on willingness to pay for farming tools and supporting materials. Research conducted by Etim & Benson (2016)

shows that farm size had a positive effect on farmers' willingness to pay for organic fertilizer in the Akwa Ibom state of Nigeria. Likewise, the research conducted by Kuwornu et al., (2017) in Ghana stated that farm size has a positive effect on farmers' willingness to pay for pellets made from manure.

However in this study, land area had a negative effect on farmers' willingness to pay for bio-slurry fertilizer. The use of bio-slurry fertilizer regularly in the long term will have an impact on improving soil quality, which is characterized by increasingly loose soil, increased production, and can prevent disease. While, oppositely, the use of bio-slurry fertilizers in the short term will have an impact on decreased crop production. Respondents who have a large land area in this study stated that

they will incur greater losses compared to farmers who had a narrow land area at the beginning of using bio-slurry fertilizer so the larger the land, the opportunity for farmers to pay bio-slurry fertilizer would be lower.

The decline in production during the initial use of bio-slurry fertilizer can be overcome combining bio-slurry fertilizer with chemical fertilizer, with a proportion of chemical fertilizer greater than bio-slurry fertilizer. Then for the next planting season, the proportion of bio-slurry fertilizer is increased and the dose of chemical fertilizer is reduced, and so on in the next planting season until the bio-slurry dose is more than chemical fertilizer, or even no using chemical fertilizer at all. Combining the proper dosage of bio-slurry fertilizer and chemical fertilizer at the initial use of bio-slurry fertilizer can reduce the risk of decreasing production.

Education

Education had a positive effect on farmers' willingness to pay for bio-slurry fertilizer. It means that the higher the education, the higher farmer's willingness to pay for bio-slurry fertilizer. Bio-slurry fertilizer was a new innovation among farmers so the most farmers who were willing to adopt and pay for bio-slurry fertilizer are dominated by farmers with higher educational backgrounds. Farmers having low education background generally did not take the risk of adopting bio-slurry fertilizer. Therefore, they also did not want to pay more for bio-slurry fertilizer. It is consistent with the previous research conducted by Manja et al., (2015) that education was a

determining factor in farmers' willingness to pay for agricultural inputs in Malawi. A high level of education indicates a critical way of thinking in decision making, especially in choosing quality products or services, so education will indirectly have a significant effect on the willingness to pay for goods or services (Okon et al., 2018).

Price of Bio-slurry Fertilizer

The previous research states that prices will be inversely proportional to WTP, or it can be said that if the prices rise then WTP will fall. As in a research conducted by Amirnejad & Tonakbar (2015) in Tehran, it was stated that the price variable had negative effect on consumer's willingness to pay for organic milk. However, in this study, the price had a positive influence on farmers' willingness to pay for bio-slurry fertilizer. This is alleged because farmers considered using bio-slurry fertilizer from benefits perspective, not the price. Based on field research, it was found that the price of bio-slurry fertilizer in Central Java was between IDR 520-1,000/kg. Farmers purchasing bio-slurry fertilizer at a higher price of IDR 1,000/kg stated that they were willing to pay bio-slurry fertilizer at that price because of the benefits obtained after using bio-slurry fertilizer is quite large, even some of them were willing to pay up to a price of IDR 3,000/kg to acquire bio-slurry fertilizer. The most of horticultural farmers (table 1) stated that bio-slurry fertilizer was proven to be effective in preventing root disease (clubroot) on cabbage and mustard

plants and could prevent anthracnose or fruit rot caused by fungi in chili plants. Therefore, the increase in the price of bio-slurry fertilizer did not negatively affect the WTP of farmers, because there were many benefits attained by farmers from using it.

Experience of Using Organic Fertilizer

The experience of using organic fertilizers is divided into two categories; not having the experience in using organic fertilizer and having the experience in using organic fertilizer other than bio-slurry. The results show that farmers with experience of using organic fertilizer, had a greater opportunity to be willing to pay bio-slurry fertilizer than farmers having no experience on it. It is consistent with the research conducted by Oti Agyekum et al., (2014) in the Southern Region of Ghana that the knowledge on faecal waste and experience of using animal manure could have a positive effect on farmers' willingness to pay for human waste fertilizers.

CONCLUSION AND SUGGESTION

The results showed that 58.75% of respondents were willing to pay bio-slurry fertilizer equivalent or more than the market price of bio-slurry fertilizer in Central Java. Farmers with high incomes and education tend to be willing to pay more for the use of bio-slurry fertilizers. Likewise, with experience of using organic fertilizer, farmers with experience of using organic fertilizer, tend to have a greater willing to pay bio-slurry fertilizer than those having no experience. The price

factor in this study had positive affect the willingness of farmers to pay for bio-slurry fertilizer. It might be caused by the high use or utility value of bio-slurry fertilizer. On the other hand, the land area factor had a negative effect on farmers' willingness to pay for bio-slurry fertilizer in Central Java. The average WTP value of respondents using bio-slurry fertilizer was IDR 937.5/kg higher than the market price of bio-slurry fertilizers in Central Java. This indicates a consumer surplus of IDR 237.5/kg. It led bio-slurry fertilizer selling opportunities to remain consistent in the market.

Production continuity needs to be maintained by producers considering the availability of bio-slurry fertilizer tends to be difficult to obtain during the seasonal rain. Sufficient knowledge is needed to produce fertilizer with good quality so that nutrients are not lost during the fermentation process in the digester. Besides, some producers do not sell bio-slurry fertilizer in the form it has been ground but rather chunks, so that it makes the price of bio-slurry fertilizer lower so that quality improvement is needed.

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