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RESEARCH ARTICLE

Factors Influencing Farmers' Willingness to Pay for NPK Fertilizer in Specialty Coffee: Insights from Pagar Alam, Indonesia

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Abstract: Productivity is a crucial issue for smallholder coffee farming in Indonesia, including Pagar Alam City, where it remains low and cannot be improved by relying solely on subsidized fertilizers. Using unsubsidized NPK fertilizers specifically for coffee is an alternative, despite being more expensive. Many studies have focused on coffee but not on farmers' perceptions and willingness to pay for these fertilizers. For this reason, this study aims to: (1) determine farmer perceptions of nutrient content, ease of use, and fertilizer quality, (2) determine farmers' willingness to pay for unsubsidized NPK fertilizer for coffee in Pagar Alam City, and (3) identify factors influencing this willingness. The research was conducted in three sub-districts with the highest and lowest coffee production in Pagar Alam City, involving 100 respondents interviewed using a questionnaire. The contingent valuation method was used to determine willingness to pay, descriptive analysis to gauge perceptions, and multiple linear regression to identify influencing factors. Results showed that farmers had a high perception of unsubsidized NPK fertilizers. The average willingness to pay was IDR. 11,160 per kg, lower than the market price. Factors such as farm income, land area, age, farming experience, number of dependents, membership in farmer groups, fertilizer quality, ease of use, and nutrient content influenced willingness to pay. This study provides insights for policymakers and the fertilizer industry in developing NPK fertilizers and determining prices based on farmers' willingness to pay.

Keywords: Willingness to Pay; Contingent Valuation Method; Robusta Coffee; NPK Fertilizer; Farming Income

1. Introduction

Robusta coffee plantations are a leading agricultural sector in Indonesia that still receive subsidized fertilizer[1] support as part of the government's efforts to increase productivity, which remains relatively low. National coffee productivity was only 618 kg per hec-

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tare in 2022, a figure significantly lower compared to the highest coffee-producing countries, which can reach up to 3 tons per hectar [2,3].

The issue of low robusta coffee productivity is also present in Pagar Alam City. Estimations of the production function parameters indicate that most coffee plantations in Pagar Alam City have low productivity[4]. This is due to the fact that the provision of subsidized fertilizers by the central government is often lower than the proposed needs by local governments[5]. The request for subsidized fertilizer in 2024 is 10.7 million tons, but the government budget allocation is only 4.8 million tons[6]. This leads to insufficient fertilization of robusta coffee by farmers, even though proper fertilization is a crucial factor in increasing agricultural productivity[7]. As a result, most coffee farmers in Pagar Alam City are unable to implement good agricultural practices[7,8].

Efforts to increase the low productivity of robusta coffee in Pagar Alam City cannot rely solely on subsidized fertilizer assistance due to the government's limited capacity to meet subsidy needs. Farmers must be able to use unsubsidized fertilizers, especially the specific use of NPK fertilizers for certain plants[9], which are widely available at affordable prices[10]. Therefore, the use of fertilizers must be done precisely to avoid resource wastage. One way to achieve this is through the use of unsubsidized NPK fertilizers with a special formula specifically for coffee[7], adjusted to the nutrient needs of robusta coffee plants and based on farmers' perceptions and willingness to pay for the fertilizer to ensure easier acceptance.

Farmers' perceptions of fertilizer use measured in this study, including nutrient content, ease of use, and the quality of unsubsidized fertilizers to be used[11–14] are very important for policymakers to formulate effective policies for better yields and productivity[15]. Farmers' perceptions are crucial for understanding consumer needs and preferences. This understanding helps fertilizer producers develop products that meet market demands, increase farmer adoption of these fertilizers, and be more responsive to consumer needs. Likewise, the value of WTP (willingness to pay), which is used to obtain a monetary measure of product quality[16], is important to understand because input prices significantly impact coffee farming activities[17]. This information is necessary to provide insights on how products can be made more farmer-oriented[12] and to help understand market demand for the product[18].

Setting the selling price of unsubsidized NPK fertilizers without considering farmers' perceptions and WTP will result in low fertilizer use by farmers[19] Unsubsidized fertilizers are relatively more expensive than subsidized fertilizers, especially during the 2021-2022 supply crisis[20] which caused unsubsidized fertilizer prices to rise significantly by 125% due to increased raw material costs as a result of the Russia-Ukraine war, the COVID-19 pandemic, climate change, natural disasters, and export restrictions by producing countries[20].

The willingness to pay for fertilizers as a production input can be influenced by various factors. Based on previous literature studies, the factors affecting farmers' willingness to pay include farm income level[14,16,21], land area[15,22], age[11,23], education level[24,25], experience in coffee farming[17,23], number of family dependents[26,27], distance from the farmer's house to the farm shop[17,26], gender[17,28], membership status in farmer groups[27], and farmers' perceptions of fertilizer use, such as nutrient content, ease of use, and fertilizer quality[11–14].

Research on farmers' willingness to pay for fertilizers in developing countries is still quite limited[28] as most studies focus on other production input aspects, especially regarding the WTP for NPK fertilizers specifically for coffee in Pagar Alam City. Additionally, no studies have combined the 12 variables influencing WTP used in this research into a single regression model. Market dynamics, such as the increase in raw material prices for NPK fertilizers[29] and the rise in global coffee prices in 2023[20] are also factors considered in this study.

Some examples include WTP for quality fertilizers in Bangladesh[30]; farmers' WTP for bio-slurry fertilizer in Central Java[31]; and farmers' WTP for unsubsidized fertilizer prices in Togo[10]. Other studies related to farmers' willingness to pay for organic fertilizers were conducted in Nigeria[12] and South Africa[13] using the contingent valuation method (CVM), as well as farmers' WTP for innovative fertilizers in Southern Greece[32] and fertilizers for plant growth[15], including measuring farmers' WTP for sustainable agriculture[14], for the global fertilizer crisis in Nepal[28], for the use of inorganic fertilizers in Southern Tanzania[33], and also for determining fertilizer distribution scenarios in Nepal, which showed that the highest WTP value is for direct delivery of fertilizers to farmers' homes when needed[34].

Based on the above description, determining the level of farmers' willingness to pay for unsubsidized NPK fertilizers specifically for coffee is crucial as it serves as a reference for policymakers in formulating

product marketing strategies. The government and fertilizer manufacturing companies must consider the selling price of quality fertilizers to align with farmers' willingness to pay[14,34]. Given its importance, this research aims to (1) understand farmers' perceptions of nutrient content, ease of use, and quality of unsubsidized NPK fertilizers specifically for coffee in Pagar Alam City, (2) determine the value of farmers' willingness to pay for unsubsidized NPK fertilizers specifically for coffee in Pagar Alam City, and (3) identify the factors influencing the value of farmers' willingness to pay for unsubsidized NPK fertilizers specifically for coffee in Pagar Alam City.

2. Materials & Method

2.1 Data Collection

South Sumatra Province has the largest coffee plantation area in Indonesia, and Pagar Alam City was chosen as the research location because it has the highest productivity level compared to other coffee-producing cities/regencies in South Sumatra Province. Pagar Alam City consists of five sub-districts, but the research was purposively conducted in only three sub-districts based on their productivity levels: North Dempo and Central Dempo sub-districts, which have the highest robusta coffee production, and North Pagar Alam sub-district, which has the lowest robusta coffee production in Pagar Alam City. This approach is expected to represent respondents from areas with varying productivity levels. To show several research locations per subdistrict in the city of Pagar Alam, refer to Figure 1 below.

The sampling technique used in this research employed a purposive sampling method, which selects samples based on specific considerations[35,36]. The exact population size of robusta coffee farmers in Pagar Alam City is unknown, so the sample size determination used the Cochran method, resulting in a sample size of 100 respondents[36,37]. Sample criteria included (1) maximum coffee farm size of 2 hectares and (2) being registered as a recipient of fertilizer subsidy assistance from the government. Sampling was conducted randomly[37], collected from November to December 2023 through direct interviews using structured questionnaires to understand the socio-economic profiles and respondents' perceptions of NPK fertilizer use in several villages within the three designated sub-districts.

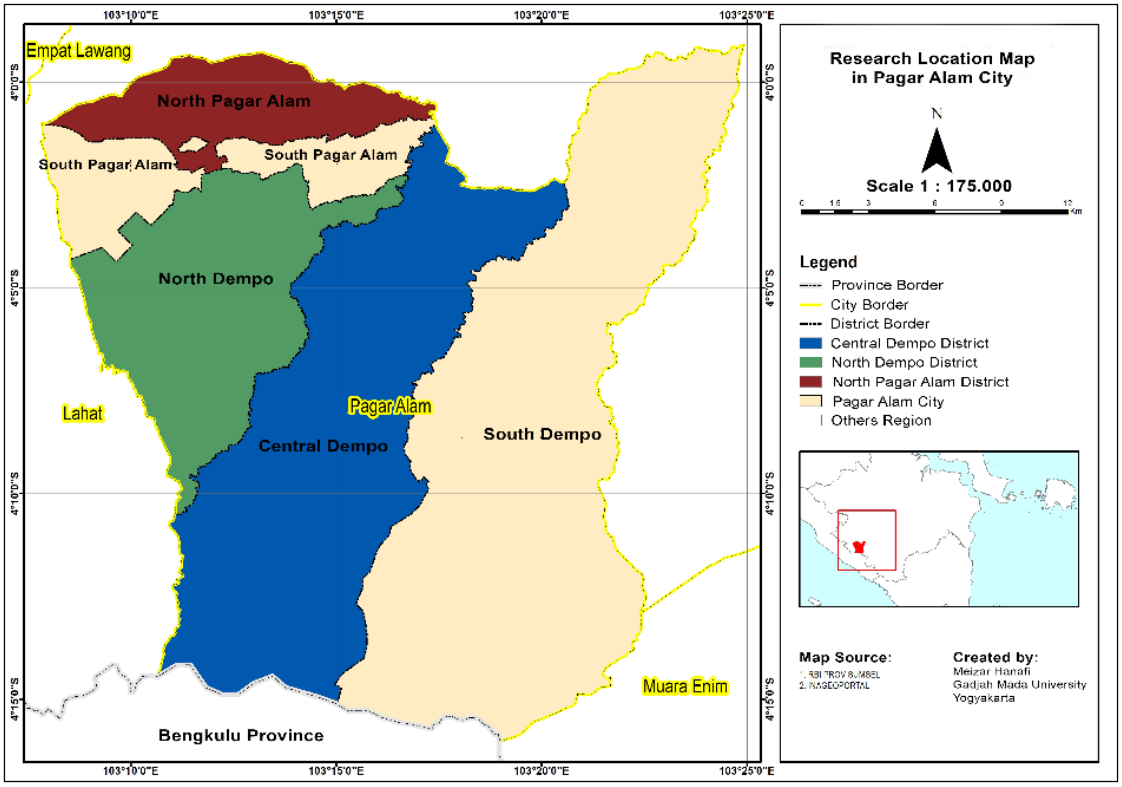

Figure 1. Research Location Map

2.2 Data Analysis

Farmers' Perceptions on the unsubsidised NPK Fertilizer

Data was collected through interviews using a questionnaire containing questions related to farmers' perceptions, including nutrient content, ease of use, and fertilizer quality. Nutrient content refers to farmers' perceptions of the important nutrients contained in the fertilizer, measured by the composition of macro and micronutrient content. Ease of use pertains to farmers' perceptions of how easily the fertilizer can be applied to plants, the availability of usage instructions, and how it can be mixed with other fertilizers. Fertilizer quality is measured by farmers' perceptions of increased crop yields and robusta coffee plant development. The 5-point Likert scale was used to assess farmers' perceptions of unsubsidized NPK fertilizers specifically for coffee. Question scores ranged from 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), to 5 (strongly agree).

Analysis of Farmers' Willingness to Pay Amount

The estimation of farmers' willingness to pay for unsubsidized NPK fertilizers specifically for coffee was conducted using the Contingent Valuation Method (CVM). Data were collected through direct interviews using a questionnaire. The operational stages of the CVM approach included constructing a hypothetical market, bidding values, average willingness to pay, bid curve estimation, and data aggregation[38].

The construction of the hypothetical market was clearly outlined in the questionnaire so that respondents could understand the potential increase in crop yields by using the offered product. The hypothetical market formulation in this study was: "The use of unsubsidized NPK fertilizers specifically for coffee can increase robusta coffee production by up to 20%, with better growth quality as evidenced by greener leaves"[39].

Farmers' willingness to pay (WTP) was obtained using the bidding game technique through interviews and questionnaires containing questions about the price of unsubsidized NPK fertilizers specifically for coffee. Respondents were asked about their willingness to pay for the fertilizer starting from an initial price of IDR. 8,000 (the lowest selling price of unsubsidized NPK fertilizers in Pagar Alam based on interview results) and increasing incrementally until reaching the maximum amount they were willing to pay[18,38]. Next, the average WTP value was calculated from the entire sample of respondents, the farmers' WTP curve was estimated, and data aggregation of farmers' WTP based on the number of coffee farmers in the population was conducted to determine the market potential for unsubsidized NPK fertilizers specifically for coffee in Pagar Alam City.

Hypothesis testing was conducted by comparing the farmers' WTP for unsubsidized NPK fertilizers specifically for coffee, as calculated, with the selling price of unsubsidized NPK fertilizers commonly used by coffee farmers in Pagar Alam City. To test this hypothesis, the Wilcoxon signed-rank test can be used with the criteria: H_0 = no difference, H_1 = difference exists. If the Asymp. Sig (2-tailed) value < 0.05, then H_0 is rejected and H_1 fails to be rejected, indicating a difference between the WTP for unsubsidized NPK fertilizers specifically for coffee and the current selling price of NPK fertilizers.

Validity Test

Before the research questionnaire was distributed to the respondents, a validity test and a reliability test were conducted on the variables of farmers' perceptions of NPK fertilizer as latent variables to ensure that the questions in the distributed questionnaire were valid and reliable.

The instrument validity is used to determine the accuracy of the measurements in assessing what is intended to be measured[35]. To determine the level of validity, the researcher uses the Pearson product-moment correlation formula with the following hypothesis criteria:

H_0: The item used is not valid

H_1: The item used is valid

Each statement item will be scored to determine whether the statement is valid or not. The scoring criteria are as follows:

a) If the calculated r ≥ r table, H_0 is rejected, meaning the question item used can be considered valid.

b) If the calculated r < r table, H_0 fails to be rejected, meaning the question item used can be considered not valid.

Realibility Test

Reliability is a series of measurements or a set of measuring instruments that are consistent when the measurements are repeated[35]. Reliability analysis using Cronbach's Alpha technique is used for testing the

reliability of this research instrument. The results of the reliability test can be interpreted as follows:

If the Cronbach's Alpha value is ≥ 0.6, the items on the research questionnaire can be considered reliable.

If the Cronbach's Alpha value is < 0.6, the items on the research questionnaire can be considered not reliable.

The Influence of Nutrient Content, Ease of Use, Fertilizer Quality, and Other Factors on Farmers' WTP

The third objective of this study can be achieved through multiple linear regression analysis, which tests the strength of the relationship between independent variables and the dependent variable[22,26]. In using multiple linear regression analysis, certain assumptions must be met to ensure the validity of the data, including tests for normality, multicollinearity, and heteroskedasticity[35].

Twelve variables are used in the model to measure factors influencing farmers' willingness to pay (WTP) for unsubsidized NPK fertilizers. The hypotheses suggest that nutrient content, ease of use, and fertilizer quality, farm income level, land area, education level, coffee farming experience, gender, and membership status in farmer groups positively influence farmers' WTP. Conversely, age and the number of dependents in the family negatively influence WTP.

Transforming Likert scale data from ordinal to interval data for use in regression analysis typically involves methods like the Method of Successive Interval (MSI). This method calculates the proportion of responses for each option on the scale used and then finds the corresponding values proportionally to achieve a normal dispersion. By using MSI, not only is the data transformed from ordinal to interval scale, but it is also adjusted to have a normal distribution, allowing parametric statistical tests to be applied[40].

The multiple linear regression model compiled and used in this study is as follows:

$$WTP = \beta_0 + \beta_1 INC + \beta_2 LS - \beta_3 AGE + \beta_4 EDUC + \beta_5 FEXP - \beta_6 HHS + \beta_7 FN + \beta_8 EU + \beta_9 FQ - \beta_{10} D\_DHM + \beta_{11} D\_MFG + \beta_{12} D\_GDR + e \quad (1)$$

Notes:
WTP : Farmer's Willingness to Pay for Unsubsidised Specific NPK Fertilizer for Coffee (IDR/kg)
β0 : Constanta
β_1- β_{12} : Regression Coefficient
INC : Farming Income (IDR)
LS : Land Size (Hectare)
AGE : Age of Respondent (year)
EDUC : Formal Education (year)
FEXP : Farming Experience (year)
HHS : Household Size (person)
FN : Farmer's Perception for Fertilizer Nutrients (Likert Score 1-5)
EU : Farmer's Perception for Ease of Use of Fertilizer (Likert Score 1-5)
FQ : Farmer's Perception for Fertilizer Quality (Likert Score 1-5)
D_DHM : Distance from Farmer House to Market (1=Near; 0=Far)
D_MFG : Membership of Farmer Group (1=Management; 0=Non-Management)
D_GDR : Gender of Respondent (1=Man; 0=Woman)
e : Residual (*error)*

3. Results & Discussion

3.1 Respondents Characteristics

Respondents in this study are robusta coffee farmers in Pagar Alam City, South Sumatra Province, totaling 100 individuals distributed across three districts: Central Dempo, North Dempo, and North Pagar Alam. The characteristics examined in this research include robusta coffee farming income, land area, age, coffee farming experience, gender, education level, number of dependents, distance from home to agricultural kiosks, and membership status in farmer groups.

The average income from robusta coffee farming is IDR. 32,052,855 per hectare per year. This high-income level is due to a global coffee price increase of up to 10.5% from the previous year[29], marking the highest prices in the past 25 years, influenced by the La Niña effect in Indonesia in 2022, which led to decreased coffee production and disrupted global supply[29]. The average land area of coffee farms for respondents is 1.04 hectares. The majority of respondents are male, aged 45 years, with an educational background of junior high school, and have an average of 19 years of coffee farming experience. They typically have three dependents in their families, with the distance between their homes and agricultural kiosks being less than 10 km. Only 21% of coffee farmer respondents are members of farmer groups. For more details regarding the characteristics of the research respondents, refer to Table 1 below.

Table 1. Farmer's Robusta Coffee Characteristics

Factors	Frequency	Mean
Farm Income (IDR)		IDR. 32,052,855
<15,000,000	9	
IDR 15,000,000 – IDR 20,000,000	10	
IDR 20,000,000 – IDR 30,000,000	28	
IDR 30,000,000 – IDR 40,000,000	25	
> IDR 40,000,000	28	
Land Size (hectare)		1.04
<0.5	21	
0.5 – 1	61	
>1	18	
Age (year)		44.91
<20	1	
21-30	10	
31-40	25	
>40	64	
Farming Experienced (year)		19.06
<5	10	
6-10	16	
11-20	37	
21-30	25	
>30	12	
Sex		Man
Man	87	
Woman	13	
Educational Qualification (Level)		Junior High School
Primary School	16	
Junior High School	28	
Senior High School	48	
Bachelor	7	
Master	1	
Household Size (Person)		3
1-2	1	
3-4	29	
Distance From Farmes's House to Farm Market		<10 km
<10 km	55	
>10 km	45	
Membership in Farmer Group		Non-Management
Management	21	
Non-Management	79	

Source: Primary Data Analysis (2024)

3.2 Farmers' Perception of Nutrient Content, Ease of Use, and Quality of Unsubsidised NPK Fertilizer for Coffee

The calculation results of farmers' perceptions using the Likert scale indicate that most farmers have a high perception of nutrient content, ease of use, and fertilizer quality. This information suggests that in the production of unsubsidized NPK fertilizers specifically for coffee, fertilizer manufacturers should pay attention to these three factors to be favored by farmers.

Table 2 shows the average level of farmers' perceptions regarding unsubsidized NPK fertilizers specifically for coffee in Pagar Alam City, which are at agree and strongly agree levels, with the highest perception level being fertilizer quality at 72%. This indicates that fertilizer quality is the most important variable for farmers in deciding to use unsubsidized NPK fertilizers specifically for coffee, with the expectation that good fertilizer quality will enhance robusta coffee production yields.

Table 2. Farmers Perceptions Percentange of NPK Fertilizer for Coffee

Factors	Strongly Agree	(%)
Ease of Use	67	67
Fertilizer Nutrients	71	71
Fertilizer Quality	72	72
Average	70	70

Source: Primary Data Analysis (2024)

3.3 The Value of Willingness to Pay for Unsubsidised NPK Fertilizer Specifically for Coffee

Information on the market price of unsubsidized NPK fertilizer was obtained through a questionnaire, with prices ranging from IDR. 8,000 per kg to IDR. 25,000 per kg, and an average price of IDR. 14,000 per kg. Initial bids to respondents started at the lowest price of IDR. 8,000 per kg, then they were asked if they were willing to pay higher than that price, and if so, it would be raised to the maximum price they were willing to pay.

The average calculated willingness to pay (WTP) of respondents for unsubsidized NPK fertilizer specifically for coffee was IDR. 11,460 per kg. This price is 20.29% lower than the average market price of NPK fertilizer in Pagar Alam City. 20% of respondents indicated willingness to pay above the market price for unsubsidized NPK fertilizer specifically for coffee, with a maximum price they were willing to pay of IDR. 16,000 per kg, while 80% of respondents had a WTP value lower than the market price of NPK fertilizer. This situation is attributed to the fact that most robusta coffee farmers have not directly seen or experienced the

results of using this fertilizer in their area, despite it being a new product specifically tailored to the nutritional needs of robusta coffee plants. For more details regarding the distribution of farmers' WTP values in the study, please refer to table 3 and figure 2 below.

Table 3. Distribution of Farmer's WTP for Unsubsidised NPK Fertilizer

Value Bids (IDR/Kg)	Respondents	fk	Mean WTP (IDR/Kg)
8,000	16	0.16	1,280
10,000	37	0.37	3,700
12,000	27	0.27	3,240
14,000	13	0.13	1,820
16,000	7	0.07	1,120
18,000	-	-	-
20,000	-	-	-
Mean WTP	100	1	**11,160**

Source: Primary Data Analysis (2024)

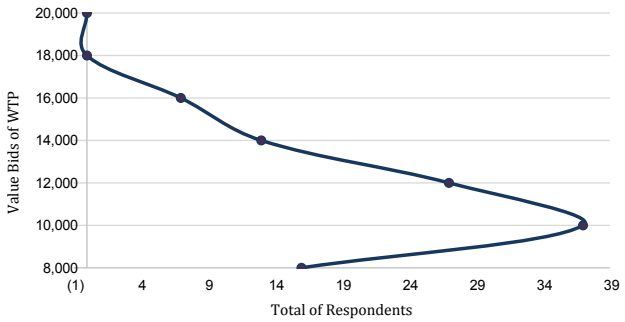

Figure 2. WTP of NPK Fertilizer Curve in Pagar Alam City

Source: Primary Data Analysis (2024)

These research findings are consistent with studies on the use of inorganic fertilizers in South Tanzania, where farmers showed a willingness to pay 15% lower than the market price of fertilizers during the observation period[33].

The hypothesis test results of the willingness to pay value of unsubsidised NPK fertilizer for coffee with the price of NPK fertilizer in the market can be known by using the Wilcoxon test. The value obtained is Asymp. Sig (2-tailed) of 0.000. the value is lower than 0.05 then Ho is rejected which means there is a difference between the two values where the WTP value of unsubsidised NPK fertilizer for coffee of IDR 11,160 per kg is lower than the NPK fertilizer commonly used by farmers in the market of IDR 14,000 per kg.

3.4 The Influence of Quality, Nutrient Content, Ease of Use of Fertilizers, and Other Factors on Farmers' Willingness to Pay

Validity & Reliability Test

Validity test is used to determine the extent to which the right measurement in measuring what is to be measured[41]. Factors of farmers' perceptions of fertilizers that allegedly affect WTP are fertilizer quality, nutrient content and ease of use known by using a Likert scale. Table 4 below shows the calculation results indicating the validity of the nine indicators of questions related to farmers' perceptions of the use of NPK fertilizer.

Table 4. Validity Test Result

Factors	Item	r-test	r-table (α1%)	Criteria
Ease of Use	1	0.729	0.256	Valid
	2	0.659	0.256	Valid
	3	0.876	0.256	Valid
Fertilizer Nutrients	1	0.870	0.256	Valid
	2	0.872	0.256	Valid
	3	0.931	0.256	Valid
Fertilizer Quality	1	0.856	0.256	Valid
	2	0.736	0.256	Valid
	3	0.755	0.256	Valid

Source: Primary Data Analysis (2024)

Reliability analysis was conducted to measure the consistency of the concept or construct being measured to ensure adequacy and reliability. To test the reliability of the three factors of farmers' perception of NPK fertilizer, Cronbach's alpha analysis was used. The lower limit of the generally accepted Cronbach's alpha value for reliability analysis is 0.7 but in exploration research the value of 0.6 is acceptable[42]. Based on this value, the Cronbach's alpha coefficient of the three factors of farmers' perceptions of NPK fertilizer more than 0.6, it can be said that the research instrument is reliable and included in the strong category. The calculation results showing the Cronbach's alpha value can be seen in Table 5 below.

Table 5. Reliability Test Result

Factors	Coeffisien *Cronbach's Alpha*	Criteria
Ease of Use	0.622	Reliable
Fertilizer Nutrients	0.870	Reliable
Fertilizer Quality	0.676	Reliable

Source: Primary Data Analysis (2024)

Classical Assumptions Test

Normality testing in this study uses the one-sample Kolmogorov-smirnov test. The significance value obtained in this study is 0.200 which means more than 0.05 so it can be concluded that the errors are normally distributed. The analytical tool used to test for multicollinearity symptoms is to look at the tolerance value or variance inflation factor (VIF). The results of the multicollinearity test on all independent variables of this study are a tolerance value of more than 0.1 and a VIF value of less than 10, which means that the regression equation model formed does not have a correlation between the independent variables, so it is concluded that there is no multicollinearity. The heterosdasticity test in this study uses the Spearman Rank correlation test. The results of the heterosdasticity test in this study show that all variables tested have a probability value > 0.05 so it can be concluded that no heteroscedasticity occurs.

Results of Regression Analysis

The regression results indicate that factors positively influencing the willingness to pay (WTP) for unsubsidized NPK fertilizer specifically for coffee in Pagar Alam City, at a significance level of α 0.01, are land size, experience in coffee farming, and fertilizer quality. This suggests that as land size increases, as does farming experience, and as the quality of fertilizer offered improves, farmers' WTP for unsubsidized NPK fertilizer specifically for coffee will increase, with a confidence level of 99%. Similar research outcomes have been observed in Sri Lanka[12], Kwazulu Natal, South Africa[30], and Ethiopia[22].

Factors such as coffee farming income, membership status in farmer groups, nutrient content, and ease of use positively influence farmers' WTP for unsubsidized NPK fertilizer specifically for coffee at a significance level of α 0.05. This indicates that as coffee farming income increases, as farmers become more active in group leadership roles, as nutrient content improves, and as fertilizer usability improves, farmers' WTP increases, with a confidence level of 95%. Other studies have also shown that these factors influence farmers' willingness to pay[11,13,15,24,34,43].

On the other hand, factors such as age and number of dependents negatively influence the WTP for NPK fertilizer. This suggests that an increase in age by 1-year decreases farmers' WTP by IDR. 54.24, and an increase in the number of dependents in the family by 1 person decreases farmers' WTP by IDR. 462.95. Several studies have similarly shown that these factors negatively impact farmers' willingness to pay for production inputs[15,17,18,24]. Table 6 below shows the coefficient values of the regression results for each variable tested as follows:

Table 6. Regression Analysis of Farmers' WTP for NPK Fertilizer

Factors	Expected Sign	Coeff	t-value	*p-value*
(Constant)	+	4139.210**	2.440	.017
Farming Income	+	4664E-5**	2.604	.011
Land Size	+	.127***	3.164	.002
Age	-	-54.249**	-2.155	.034
Formal Education	+	28.112ns	.527	.600
Farming Experience	+	75.177***	2.664	.009
Household Size	-	-462.956*	-1.727	.088
Distance From Farmer House to the Market	-	-408.056ns	-1.496	.138
Membership in Farmer Group	+	784.897**	2.346	.021
Sex	+	-379.486ns	-.928	.356
Fertilizer Nutrients	+	279.278**	2.100	.039
Easy to Use of Fertilizer	+	285.880**	2.264	.026
Fertilizer Quality	+	407.707***	2.904	.005
Adjusted R2	:	0.709		
R2	:	0.744		
Prob F Statistic	:	0.000		
Notes:				
*	:	Sig at α = 10% (*trust level* 90%)		
**	:	Sig at α = 5% (*trust level* 95%)		
***	:	Sig at α = 1% (*trust level* 99%)		

Source: Primary Data Analysis (2024)

4. Discussions

Farmers' perceptions of nutrient content, ease of use, and fertilizer quality are crucial for understanding consumer needs and preferences. This understanding helps fertilizer producers develop products that meet market demands, increase farmer adoption of these fertilizers, and be more responsive to consumer needs.

The farmers' willingness to pay (WTP) for unsubsidized NPK fertilizer specifically for coffee is lower than the market price. This finding contrasts with most studies on fertilizer WTP, where WTP values are typically higher[11,12,31]. This difference is primarily because most farmers have not directly experienced the benefits of the fertilizer, despite being informed through hypothetical markets. Another contributing factor is the significant increase in market prices for unsubsidized NPK fertilizer due to rising raw material costs and the COVID-19 pandemic[19,32], positioning market prices above farmers' willingness to pay.

Unsubsidized NPK fertilizer specifically for coffee is of high quality, formulated specifically for coffee plants. However, if the offering price exceeds farmers' willingness to pay, farmers are likely to resist because price significantly influences purchasing decisions. Competitive pricing is crucial as it reflects product value[44], and fertilizer businesses can consider adjusting prices to align with farmers' willingness to pay[11,45]. Despite constraints in fertilizer supply, farmers can enhance their willingness to pay under certain conditions[28].

Regression results indicate that age and the number of dependents negatively affect farmers' WTP. Increasing age and the number of dependents decrease farmers' willingness to pay. To boost WTP among older farmers, one strategy could involve enhancing their confidence through education about the benefits of using unsubsidized NPK fertilizers specifically for coffee[9]. Alternatively, targeting younger farmers as customers or providing microcredit assistance to farmers facing financial constraints due to family responsibilities could also be effective.

Respondents with larger land holdings, more farming experience, and a focus on fertilizer quality are likely to have higher WTP for unsubsidized NPK fertilizers specifically for coffee compared to other factors. In the long term, the socio-economic impact at the micro level on respondents meeting these criteria could enhance crop productivity and welfare due to the use of high-quality production inputs. At the macro level, this could lead to increased foreign exchange earnings and taxes from increased coffee exports, contributing to global coffee supply stability.

5. Implications

Based on the perceptions and farmer's willingness to pay, fertilizer companies can formulate policy implications to enhance farmers' willingness to pay. Strategies may include marketing efforts focused on nutrient content, ease of use, and fertilizer quality in producing NPK fertilizers. Additionally, adjusting the selling price of NPK fertilizers by using more economical raw materials, direct promotion through plot demonstrations, home delivery of fertilizers, and ensuring availability when needed are crucial considerations[34].

The results of this study can be used by fertilizer producers to develop more effective precision fertilization strategies. By understanding the factors that influence WTP, producers can adjust their products and pricing to better match the needs and financial capabilities of farmers. For the government, the findings can aid in formulating more targeted subsidy and assistance policies, thereby reducing the burden on the national budget.

From a theoretical perspective, coffee-specific fertilizers test the theory of value addition from agricultural innovations and their impact on productivity and profitability. Practically, they enhance production efficiency, increase yields, and reduce negative environmental impacts. Socially, they boost income and well-being for farmers and improve the reputation of local coffee brands.

6. Limitations

This study has several limitations, including a relatively small sample size and a limited geographical scope confined to three districts in the City of Pagar Alam, which may not adequately represent the overall population. Future researchers interested in the use of fertilizers for coffee are recommended to increase the sample size and expand the research coverage to the entire City of Pagar Alam, encompassing a variety of conditions, to obtain a broader understanding of the willingness to pay (WTP) for unsubsidized NPK coffee-specific fertilizers.

7. Conclutions

Farmers' perceptions of nutrient content, ease of use, and quality of unsubsidized NPK fertilizers specifically for coffee are highly important, with fertilizer quality being perceived as the most crucial variable. The average WTP of farmers for using unsubsidized

NPK fertilizers in Pagar Alam City is IDR 11,160 per kg, which is lower than the market price of NPK fertilizers.

Factors positively influencing farmers' WTP for unsubsidized NPK fertilizers specifically for coffee include income level, land area, farming experience, membership status in farming groups, ease of use of NPK fertilizers, nutrient content of NPK fertilizers, and the quality of fertilizers to be used. On the other hand, age and the number of dependents in the family negatively affect farmers' willingness to pay.

Author Contribution

Meizar Hanafi, Irham, and Lestari Rahayu Waluyati contributed to designing the research. Meizar Hanafi conducted data collection in Pagar Alam City and data processing. Irham and Lestari Rahayu Waluyati provided input and inteetation of research results. All authors read and agreed on the final manuscript.

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Data Availability

Not Available

Conflict of Interest

The authors disclosed no conflict of interest.

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