

Analysis of Willingness to Pay for Hydroponic Vegetable Consumers and its Affecting Factors in Medan City

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Abstract

Hydroponic vegetables appear to be one of the healthier vegetable selections compared to conventional vegetables, the high cost of hydroponic vegetables does not prevent people from continuing to consume hydroponic vegetables. This study aims to determine what factors influence consumers to buy hydroponic vegetables in the study area, using logistic regression analysis derived from primary data. The results showed that the Willingness to Pay value for hydroponic vegetables was 9.1% - 13.6% higher than the price offered. Meanwhile, the variables that significantly affect consumers' willingness to pay more for hydroponic vegetables are income, education level, age and packaging. The number of family members does not have a significant effect on consumers' willingness to pay for hydroponic vegetable products.

Keywords: Hydroponic Vegetables, Willingness to Pay, Logistic Regression and CVM

Introduction:

The development of the eras has led to an accumulative population which has resulted in massive land conversion and a decrease in soil fertility. Limited agricultural land and reduced soil fertility have resulted in a decrease in the quality and quantity of vegetables produced. Therefore, a system is needed that does not use a lot of land, but also contains a lot of nutrients that can support vegetable productivity. The hydroponic vegetable cultivation system is one solution to this problem.

One way to produce high-quality vegetable products continuously with a high quantity per plant is cultivation with a hydroponic system. This hydroponic technology has many advantages compared to traditional farming techniques. The advantages of hydroponics include being environmentally friendly, the products produced are hygienic, plant growth faster, the quality of crop yields can be maintained, and the quantity can be increased. Vegetables produced

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with a hydroponic system are also healthier because they are free from industrial heavy metal contamination in the soil, fresh and durable and easy to digest.

The high public attention to health makes the hydroponic farming system, especially for hydroponic vegetable commodities, a great opportunity to be developed. Therefore, even though faced with various kinds of obstacles such as production costs, many hydroponic vegetable producers have sprung up in Indonesia.

Breidert et al., (2005) state that the basis for designing a pricing strategy is to set product prices given how much customers are willing to pay for each product. Marketers need to predict how many products offered will be purchased at different prices. Therefore, observations regarding the price that consumers are willing to pay are important things that need to be done by hydroponic vegetable producers so that consumers do not switch to other products and producers have more possibilities to achieve maximum profits.

The interesting thing is that even though hydroponic vegetables are relatively more expensive, some consumers prefer to switch to hydroponic vegetables. This is due to the increasing level of consumer awareness of health, increasing income and current lifestyles, thus causing an increase in consumer demand for hydroponic vegetables.

Seeing the enthusiasm of the community in consuming hydroponic vegetables and public awareness that prioritizes health and other reasons such as having a more delicious taste. As well as the existence of sustainability in purchasing hydroponic vegetables at prices that are relatively higher than conventional vegetable prices.

The purpose of this research is to analyze the Willingness to Pay the value of hydroponic vegetable consumers and to analyze the factors that influence the Willingness to Pay of hydroponic vegetable consumers in the city of Medan.

Research methods:

Site Selection Method: The selection of research locations was carried out purposively (purposive sampling) in Medan City with the consideration that Medan City is also the area with the largest population in North Sumatra Province and has hydroponic vegetable production centres. This research was conducted in April - August 2022.

Method of collecting data: Data collection was carried out using interviews assisted by questionnaires. The data taken in this study are primary data and secondary data. Primary data were obtained from interviews with 100 hydroponic vegetable consumers at predetermined hydroponic cultivation locations. While secondary data was taken from various sources such as the Ministry of Agriculture, previous researchers, libraries, and other valid sources that support the research.

Population and Sample: Sampling in this study used a judgment sampling technique. Judgment sampling was carried out because the population of hydroponic vegetable consumers in Medan City was not recorded. The number of samples obtained for research is equal to 100 respondents. The criteria set in the selection of respondents include respondents who have purchased hydroponic vegetables at least once, respondents who are adults with a minimum age of 17 years, have income and are responsible for food spending both for themselves and their families.

Data analysis method: In this study, to calculate the willingness to pay (WTP) of hydroponic vegetable consumers in Medan City thus the Contingent Valuation Method (CVM) is used. The

CVM approach is a survey method that is carried out by directly asking respondents individually. The steps taken to obtain the WTP value are: firstly building a hypothetical market (setting up the hypothetical market), secondly determining the auction value of willingness to pay (obtaining bids) based on product prices known to respondents, thirdly determining the alleged average willingness to pay value, the fourth is to make a Willingness to Pay curve, and finally to aggregate the willingness to pay data.

The factors that influence the willingness to pay for hydroponic vegetables in Medan City can be calculated using logistic regression analysis. Logistic regression analysis is part of the regression analysis, in which this analysis examines the relationship of the independent/free variable (X) to the dependent/dependent variable (Y) through a certain mathematical equation model. Based on literature studies and field conditions, several variables are thought to influence the willingness to pay for hydroponic vegetables including income, education, dependents, age and packaging. The regression equation is as follows

$$Y = \frac{e^{\beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5}}{1 + e^{\beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5}}$$

Description:

Y = Willingness of consumers to pay (yes/no)

Y = 0 = not willing to pay

Y = 1 = willing to pay

β_0 = Regression constant

$\beta_1,2,3,5$ = Regression coefficient

X1 = Income

X2 = Education

X3 = Dependents

X4 = Age

X5 = Packaging

e = Setting e

Furthermore, the test used is the statistical G test to test the role of explanatory variables simultaneously and the Wald test to test the effect of the variable coefficients partially, while for the interpretation of the binary logistic regression equation, the odds ratio is used. The odds ratio is the ratio of the chances of success and failure of the response variable.

The following are the steps for testing the hypothesis:

1. The value of $\beta = 0$ means that the variable does not affect consumers' willingness to pay / not willing to pay consumers for hydroponic vegetables,
2. The value of $\beta \neq 0$ means that the variable affects the willingness to pay consumers / not willingness to pay consumers for hydroponic vegetables.

At a significance level (α) of 5%, H_0 is accepted if the Asymptotic Significance value > significance level (α) states that the independent variable does not affect the dependent variable. H_1 is accepted if the Asymptotic Significance value < the significance level (α), this states that the independent variable affects the dependent variable. Interpretation of the Odds ratio which is

the ratio of the probability of successful and unsuccessful events is from the dependent/dependent variable. The interpretation of the odds ratio is a measure of risk, or the tendency to experience certain events between one category and another, which in this study are willing or unwilling to pay more to obtain hydroponic vegetable products

Results and Discussion:

Analysis of Willingness to Pay for Hydroponic Vegetables in Medan City: Respondents in this study amounted to 100 people and 92% of them were willing to pay more for hydroponic vegetables. The remaining 8% are not willing to pay more for hydroponic vegetables. The value of consumers' willingness to pay for hydroponic vegetables in Medan City is carried out using the Contingent Valuation Method (CVM) approach consisting of the following steps, namely:

Building a Mortgage Market: Respondents were given information about improving the quality of conventional vegetables into hydroponic vegetables so that respondents had an idea of the intended hypothetical market situation. Respondents are expected to be able to observe properly so that they can provide the maximum WTP value.

Determining the WTP Auction Value: The amount of the WTP's auction value is obtained by the bidding game method. It is through this technique the respondent is asked repeatedly whether they want to pay a certain amount. If "yes", then the amount of the money value is increased to an agreed level.

Determining the average value of WTP: The respondent's WTP value is calculated based on the respondent's WTP distribution data. The results of the calculation of the average WTP for hydroponic spinach commodities were Rp. 5,682 per pack, hydroponic kale commodities were Rp. 4,482 per pack, hydroponic *pakcoy* (Chinese cabbage) commodities were Rp. 7783 per pack, hydroponic *samhong* (curly mustard) commodities were Rp. 6648 per pack and hydroponic lettuce commodities were Rp. 7639 per pack. This value reflects the magnitude of the respondents' willingness to pay for the implementation of improving the quality of conventional vegetables into hydroponic vegetables. the formula used is:

$$EWTP = \frac{\sum_{i=0}^n \cdot Wi}{n}$$

Description:

EWTP = Average WTP value

Wi = WTP value that is willing to pay

I = Respondent i who is willing to pay for hydroponic vegetables

n = Number of respondents

The percentage increase in the initial price with the average WTP of hydroponic vegetables is as follows:

Table 1: The percentage increase in the initial price with the average WTP of hydroponic vegetables²

Hydroponic Vegetable Types	Initial Price (Rp)	Maximum average WTP (Rp)	Increase (%)
Spinach	5000	5682	13.6
<i>Kangkung</i> (Water Spinach)	4000	4482	12.1
Pak Choi (Chinese Cabbage)	7000	7783	11.2
Samhong	6000	6648	10.8
Lettuce	7000	7639	9.1

WTP curve:

The WTP curve is a curve that has two axes that show the relationship between the amount consumers are willing to pay and the cumulative frequency of respondents. This curve shows that the lower the price offered, the more consumers like that price. In addition, this curve also shows the existence of a dominant value/price range chosen by consumers. The following presents the WTP curve for each commodity:

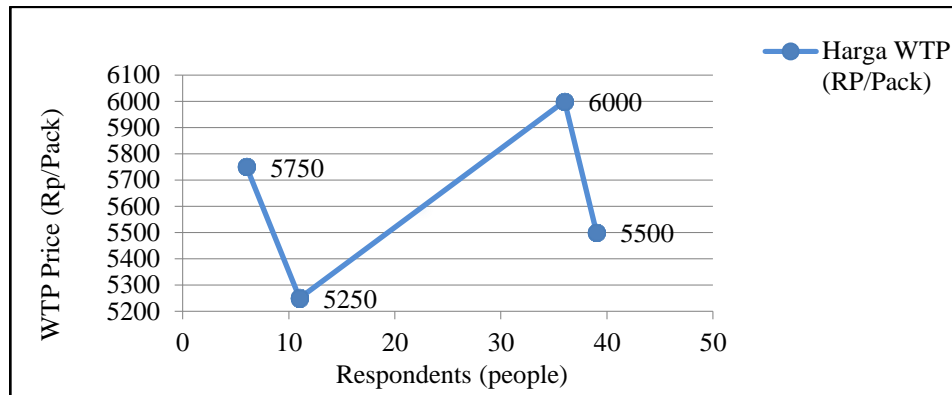


Figure 1: Spinach WTP Curve (Rp/Pack)

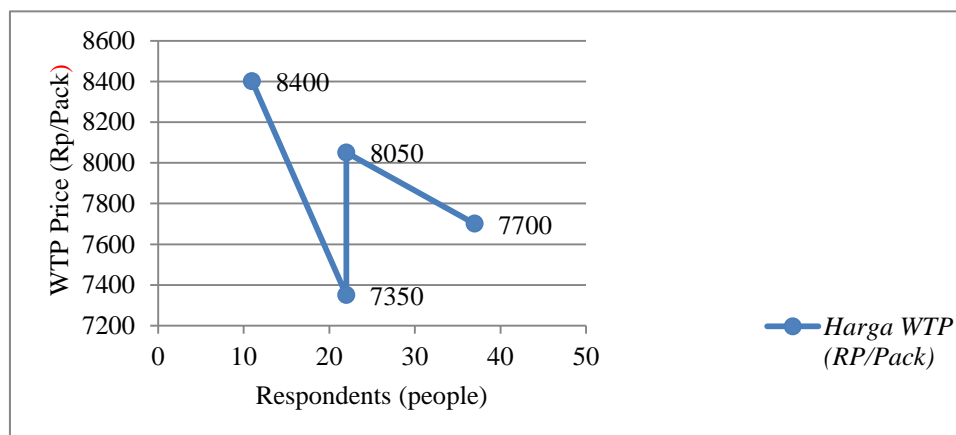


Figure 2: Pak Choi WTP Curve (Rp/Pack)

² Source: Processed data (2022)

Description:

Harga WTP = WTP Pricing

The Spinach and Pakcoy WTP curves are zigzag (up-down) or varied movements and the endpoint is not always the highest. This indicates that respondents are willing to pay a higher price at a certain level and decline at a higher level as well.

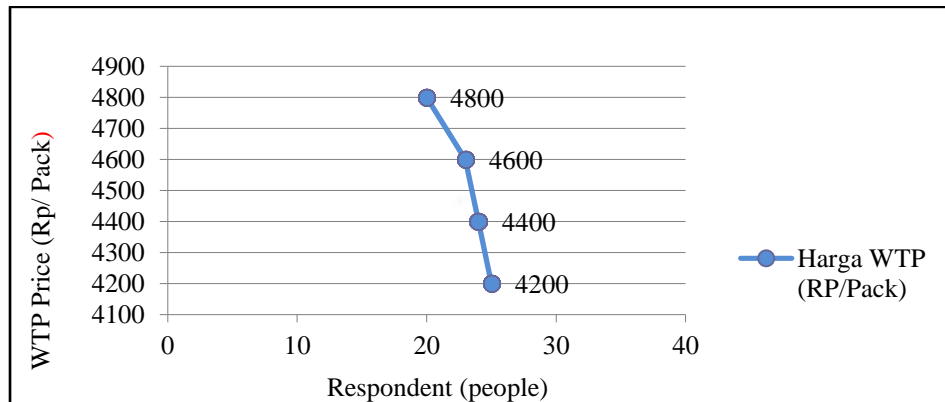


Figure 3: Water Spinach (*Kangkung*) WTP Curve (Rp/Pack)

The purchase of kale shows a negative slope, meaning that the higher the Willingness to pay the value of the respondent, the less the cumulative frequency of respondents who are willing to pay, that is, the higher the price that respondents are willing to pay, the smaller the number of respondents who are willing to pay at that price. The lowest WTP value is Rp. 4200 and the highest WTP value is Rp. 4800.

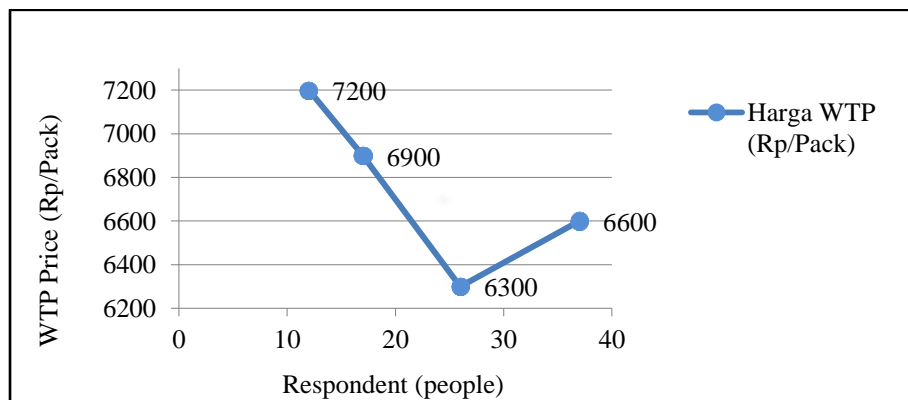


Figure 4: *Samhong* WTP Curve (Rp/Pack)

Samhong's WTP curve shows upward and rightward movement. This shows that there are respondents who are willing to pay higher prices. Even though the lowest point is not always the initial value or auction point, the tendency of the curve to move to the right is up, this indicates an increasing WTP value and a movement of the curve to the right indicates an increase in the number of respondents who are willing to pay more even though the price of hydroponic vegetable products is increasing.

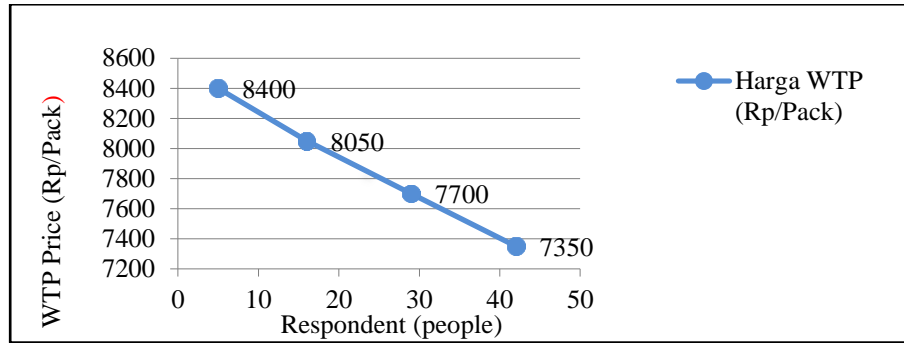


Figure 5: Lettuce WTP Curve (Rp/Pack)

The WTP curve of lettuce shows the movement of the curve downward and to the right. This shows that the WTP value is increasing and the movement of the curve to the right indicates a decrease in the number of respondents who are willing to pay more which shows that respondents are not willing to pay more if the WTP price increases.

PAP aggregation:

The WTP aggregation is the overall value of the WTP value that is willing to be paid by respondents who are willing to pay in this study. The WTP aggregation value needs to be known so that marketers get information about the sales value with the maximum value that consumers are willing to pay from the sale of each type of vegetable. The results of the WTP aggregation calculation can be seen in the following table:³

Table 2: The results of the WTP aggregation calculation⁴

No.	Type of Vegetables	WTP aggregation
1.	Spinach	Rp 522.750 / Pack
2.	<i>Kangkung</i> (Water Spinach)	Rp 412.400 / Pack
3.	Pak-choi	Rp 716.100 / Pack
4.	Samhong	Rp 611.700 / Pack
5.	Lettuce	Rp 702.800 / Pack

It is known that the total WTP for spinach is IDR 522,750 / pack, kale is IDR 413,400 / pack, Pakcoy is IDR 716,100 / pack, Samhong is 611,700 / pack and Lettuce is 702,800 / pack.

Factors Affecting Willingness to Pay (WTP) Logistic Regression:

Logistic regression analysis was used to determine the factors that influence the willingness to pay for hydroponic vegetables.

³ Source: Research Primary Data, 2022

⁴ Source: Research Primary Data, 2022

G test:

Table 3: Hosmer and Lemeshow Test⁵

Chi-square	Df	Sig.
1.116	8	0.997

The independent variables that are thought to influence consumers’ willingness to pay for hydroponic vegetable products are income, education, dependents, age, and packaging. The results of the G test are listed in the Hosmer and Lemeshow Test Tables. This is a test to determine the accuracy of the model that has been formed. The sig value of the Hosmer and Lemeshow Test ($0.997 > \alpha = 0.05$), means that H0 is accepted, namely, the logistic regression model can explain the data and there is no difference between the model and the observed value. This shows that the logistic regression equation can be used to explain the relationship between the independent variables and the dependent variable.

Table 4: Classification Table⁶

Overall Percentage (%)	95.00
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Based on the results of the Classification Table output, the predictive ability of this logistic regression model is obtained with a total success rate of 95.0% of the conditions that occur, which means that the research model used is feasible.

Table 5: Omnibus Tests of Model Coefficients (model)⁷

Chi-square	Df	Sig.
33.163	5	0.000

Based on the output results in the Omnibus Test Table of Model Coefficients, it can be seen that the chi-square value obtained is 33.163 with degrees of freedom = 5 and $p = 0.000$. Because the value of $p = 0.000 > \alpha = 0.05$, it can be concluded that H0 is rejected or the independent variables simultaneously have a significant effect on the dependent variable or WTP.

Table 6: Model Summary⁸

-2Log likelihood	Cox & Snell R Square	Negelkerle R Square
22.591	0.282	0.660

The output results in the Summary Model look at the ability of the independent variables to explain the dependent variable. The Negelkerle R Square value of 0.660 indicates that the ability of the independent variables to explain the dependent variable is 66.0% and there are 34.0% of other factors that explain the dependent variable outside of this study.

⁵ Source: Processed Data (2023)

⁶ Source: Processed Data (2023)

⁷ Source: Processed Data (2023)

⁸ Source: Processed Data (2023)

Wald’s test:

Based on the results of the Wald test in the table, the independent variables that have a p-value $< \alpha$ (0.05) affect the dependent variable or willingness to pay partially.⁹

Table 7: Wald test

Variables	Koef (B)	Wald	P-value(sig.)	Odds Ratio(Exp(B))	Remarks
Income (X1)	1.405	5.719	.017	4.074	Has Effect
Education (X2)	.282	.175	.006	1.325	Has Effect
Dependants (X3)	.860	1.572	.210	2.363	No Effect
Age (X4)	-.048	.228	.004	.953	Has Effect
Packaging (X5)	4.208	7.357	.007	67.239	Has Effect

The income factor has a significant effect on the willingness to pay for hydroponic vegetables (0.017 $<$ 0.05). Based on this research, most consumers with various income variations are willing to consume hydroponic vegetables. This is not following the opinion of Fazrina et al. (2013) who argued that high income allows consumers to carry out better activities or other needs because they have sufficient funds. This is because in this case, the price of hydroponic vegetables tends to be higher than conventional vegetables.

The educational factor influences the willingness to pay for hydroponic vegetables (0.006 = sig $<$ 0.05). Based on research, some consumers who have a higher level of education are willing to buy hydroponic vegetables as a good quality food for themselves. This is following the opinion expressed by Tinambo & Sunaryanto (2021) that a person’s educational level is one of the aspects involved in making a consumer decision. This is because consumers with a high level of education tend to have a desire to live a healthy life by consuming hydroponic vegetables.

The variable of dependents or the number of family members is a factor that does not significantly influence consumers’ willingness to pay to obtain hydroponic vegetable products because the p-value $>$ α (0.210 $>$ 0.05). This is in line with the opinion of Krystallis & Chryssohidis (2005) who states that the number of family members and the presence of children in the household do not affect the frequency of purchases and willingness to pay a premium to obtain hydroponic food products. Many or few family members do not affect consumer purchasing decisions in buying hydroponic vegetables. This is because the number of members is a consideration for consuming a product so that it is effective and efficient for family survival.

The age variable obtained a significant value with a calculated value (0.004 $>$ 0.05) (p sig. $>$ α) thus indicating that the age variable had a significant effect on consumers’ willingness to pay for hydroponic vegetables. This happens because, from the results of observations, the average age of hydroponic vegetable consumers is in the age range of 35-45 years. This is where at that age a person is more concerned with his health in consuming vegetables. The age variable has an odd ratio based on an Exp (B) value of 0.953 which indicates that the probability of willingness to pay for hydroponic vegetable products at an adult age is 0.953 times greater than the age of young respondents (adolescents).

The packaging factor influences the willingness to pay for hydroponic vegetables (0.007 $<$ 0.05). Based on this research, the packaging used by producers is of particular concern to consumers in their willingness to pay. This is in line with Ampuero and Vila’s (2006) research which says that product packaging influences purchasing decisions. Meanwhile, research from

⁹ Source: Primary Data Processed (2023)

Wells et al., (2007) states that packaging acts as a tool for differentiation and helps consumers to decide on products from a variety of similar products. In addition, packaging also stimulates customer buying behaviour. So the better the packaging used, the greater the chance of willingness to pay for hydroponic vegetable products at a higher price compared to packaging that only uses ordinary plastic (not good).

Conclusion:

Based on the results of the study it can be concluded that the Willingness to Pay of consumers for hydroponic vegetables (spinach, kale, *pakcoy*, *samhong* and lettuce) at hydroponic vegetable producers in Medan City is higher by 9.1% - 13.6% from the price offered at the time of the study. The highest percentage increase in WTP for hydroponic vegetable product consumers was spinach and the lowest was lettuce. Therefore, Factors that significantly influenced the willingness to pay (WTP) for hydroponic vegetables in Medan City were age education and packaging. Meanwhile, the income and dependent factors do not have a significant effect.

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