# ANALYSIS OF FACTORS AFFECTING THE DEMAND FOR SOYBEAN IN NORTH SUMATRA PROVINCE

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## Abstract

*A soybean is a food crops and vegetable proteins source important for people in North Sumatra Province. A soybean demands increased from year to year in North Sumatra Province but A soybean production decreased from year to year in North Sumatra Province. It caused by several factors such as a population growth, percapita income, and change in food consumption patterns with economic growth in North Sumatra Province. Therefore, the purpose of this study is to analyze a factor that influences soybean demand in North Sumatra Province. The data used a secondary data sourced in the form of time series from 2005 –2015. The analysis model is a double linear regression The partial t-test result showed that the of corn price, total population, percapita income and amount of industry for consumption has a significant influence on soybean demand in North Sumatra Province. While soybean price and amount of industry for feed influence not significant to soybean demand in North Sumatra Province. Price elasticity value smaller than one hence elasticity has inelastic. Cross elasticity of corn price has negative and it is complementary goods for soybean. Percapita income elasticity value is positive sign hence this thing indicates that soybean normal goods.*

Keywords: ***Demand, Soybean, Elasticity, North Sumatra***

## 1. INTRODUCTION

Indonesia is a country in Southeast Asia that is crossed by the equator and the 4th most populous country in the world. Indonesia has a tropical climate so it is rich in natural resources, various types of plants can thrive in Indonesia. Therefore, almost half of Indonesia's population makes a living in the agricultural sector. The agricultural sector is one that supports the Indonesian economy through the export of products from the agricultural sub-sectors owned by Indonesia, one of which is the food crops sub-sector.

The food crop sub-sector as part of the agricultural sector has an important role in realizing national food security, regional development, poverty alleviation, employment and foreign exchange earnings, as well as being a puller for the growth of upstream industry and a growth driver for downstream industries that contribute quite significantly to growth. national economy. The food crops, namely rice, corn and soybeans have been empirically proven, both during normal economic conditions and when facing a crisis (Tambunan, 2007).

At this time the development of the food and feed industry made from soybeans as well as the increasing demand for food, has made the demand for soybeans in Indonesia very high. On the other hand, the level of domestic soybean production tends to decrease, so that the soybean deficit that continues to increase is met by imported soybeans. This causes Indonesia to still import large amounts of soybeans (Central Bureau of Statistics, 2009).

North Sumatra Province is one of the areas where people consume soybeans, apart from being used as food for soybeans as well as animal feed and input in farming. Currently, in North Sumatra Province, industries that sell processed foods made from soybeans are increasing and followed by the increasing need for animal feed for livestock and inputs in farming, making the demand for soybeans in this area quite high. The high demand for soybeans for food, feed and input consumption needs in farming every year in North Sumatra Province is not directly proportional to soybean production in North Sumatra Province.

High soybean demand causes a soybean deficit due to low soybean production, so to meet the soybean deficit, North Sumatra Province imports soybeans in large quantities to meet soybean demand in North Sumatra Province.

The development of the number of imported soybeans in North Sumatra Province from 2005-2015 can be seen in the following data:
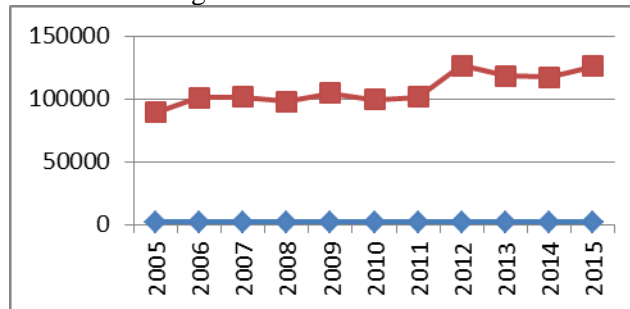


**Image 1** Demand for Imported Soybeans from North Sumatra Province

Based on Figure 1, it can be seen that the demand for imported soybeans from 2005-2015 is quite high, this occurs because the availability of soybeans and the rate of soybean production in North Sumatra Province are still low, thus making the gap between production and demand for soybeans widening.

The population increase in North Sumatra Province continued to increase from 2010 to 2016. In 2010 there were 12,982,204 people and in 2016 there were 14,102,911 people (Central Bureau of Statistics, 2016). The increase in population is usually followed by an increase in the demand for a commodity because in these conditions more people will need the commodity. The population in North Sumatra Province is increasing every year so it can be said that the need for soybeans is also increasing (Sugiarto, 2000). In line with the increase in population and the development of the food, feed and input industries in farming made from soybeans, it is estimated that the rate of demand for soybeans will continue to increase.

The demand for an agricultural commodity is the quantity of agricultural commodities demanded or required for consumption by consumers, either directly or processed through industry. The high and low demand for agricultural commodities is generally influenced by the price of the good itself, the price of other goods, the number of consumers and consumer income. The higher the price of the good, the lower the quantity demanded of the commodity. If the change in the level of consumer income increases, the demand for commodities will increase, this is because of the high purchasing power of consumers. Furthermore, the increase in population will cause the number of commodities demanded to increase, due to increasing consumption for the community. Prices of other commodities, namely the prices of substitute or complementary commodities which are substitutes or complements to a commodity, if the commodity is a substitute commodity, the higher the price of the substitute commodity it will increase the demand for a commodity and vice versa. Furthermore, if the number of industries made from raw materials of a commodity is increasing, the demand for that commodity will be higher. (Hanafie, 2010). Based on this description, this study aims to determine the factors that influence soybean demand and to analyze the elasticity of soybean demand in North Sumatra Province.

## 2. RESEARCH METHODOLOGY

This research was conducted in North Sumatra Province. Determination of the research location using the purposive method or intentionally with the consideration that North Sumatra Province is an area that has great potential for soybean cultivation and is an area that has the largest population on the island of Sumatra.

The data used in this study is secondary data in the form of times series data with a range from 2005 to 2015 using quarterly data. The secondary data used in this study were obtained from

the Central Statistics Agency of North Sumatra Province, the Food Security Agency of North Sumatra Province, the North Sumatra Provincial Agriculture Office, the North Sumatra Province Trade and Industry Office and various literatures related to this research. The data collected are soybean demand, soybean prices, corn prices, population income, population, number of industries for consumption and number of industries for animal feed.

This research method is descriptive quantitative and uses multiple linear regression analysis to analyze the influence between the dependent variable and the independent variable. The function created in the multiple linear regression model to analyze the factors that affect soybean demand in North Sumatra Province are as follows:

$$Qd = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + \mu$$

Information :
Qd                 = Demand for soybeans (Tons)
X1                 = Price of soybeans (Rp/Kg)
X2                 = Price of corn (Rp/Kg)
X3                 = Total population (Soul)
X4                 = income per capita (Rp/capita)
X5                 = Number of industries for consumption (Units)
X6                 = Number of industries for animal feed (Unit)
a                 = Constant
b1,b2,b3,b4,b5,b6      = Regression coefficient
μ                 = Error

## 2.1 Classical Assumption Test

Before carrying out statistical tests, it is necessary to test assumptions to detect the fulfillment of the assumptions in the multiple linear regression model.

1. Normality test

The normality test is a test to see whether the residuals are normally distributed or not. The way to detect it is by looking at the normal probability plot. With the test criteria, if the residuals are in the area of the diagonal line and follow the direction of the diagonal line, the residuals are normally distributed and the normality test is met, but if they are far from the diagonal line, the residuals are not normally distributed (Gujarati, 2003).

2. Heteroscedasticity Test

Heteroscedasticity test aims to see whether the variables have the same variance or not. Testing the symptoms of heteroscedasticity in multiple linear regression equations can be identified by the scatter plot method. It is hoped that there will be no heteroscedasticity, i.e. there is no clear pattern, and the points spread irregularly, so there is no heteroscedasticity (Sunyoto, 2011).

3. Multicollinearity Test

MUlticolinierity is the existence of a perfect linear relationship (correlation) between some or all of the variables that explain the regression model. One of the assumptions of the classical linear regression model is that there is no multicollinearity among the independent variables included in the model. To detect the presence or absence of multicollinearity, it can be done by looking at the variable tolerance and Variance Inflation Factor (VIF) with the following test criteria:

If tolerance       0.10 means that there is multicollinearity.
If tolerance       0.10 means that there is no multicollinearity.
If VIF    10 means that there is multicollinearity.
If VIF    10 means that there is no multicollinearity.

4. Autocorrelation Test

The autocorrelation test is a test to see if there is a relationship between period t and the previous period. Usually this happens in time series data. The Durbin Watson method (DW Test) was used to determine the presence or absence of autocorrelation (Santoso, 2001). The Durbin-Watson test criteria are as follows:

1. Durbin-Watson value below -2 means there is a positive auto correlation.
2. The Durbin-Watson value between -2 to 2 means that there is no autocorrelation.
3. A Durbin-Watson value above 2 means that there is a negative autocorrelation.

**2.2 Test Statistics**

1. Coefficient of Determination (R2)

The coefficient of determination (R2) shows the percentage of the effect of the dependent variable which is explained by changes in the independent variable. The value of the coefficient of determination (R2) is between $0 < R2 < 1$, with the test criteria, namely (R2) which is getting closer to 1, indicating that the model formed is able to explain the diversity of the dependent variable.

2. Simultaneous Test (F Test)

F test is a test simultaneously (simultaneously) the effect of the independent variable on the dependent variable to determine whether the independent variable simultaneously (simultaneously) has a significant effect or not on the dependent variable. The degree of error (α) used is 5% or significant 0.05 (Sugiyono, 2014). The criteria for testing the simultaneous test (F test) are as follows:

a. If sig. F 0.05 then simultaneously soybean prices, corn prices, population, income, number of industries for consumption and number of industries for animal feed have a significant effect on soybean demand.

b. If sig. F 0.05 then simultaneously soybean prices, corn prices, population, income, number of industries for consumption and number of industries for animal feed have no significant effect on soybean demand.

3. Partial Test (t Test)

The t-test is a partial test of the effect of the independent variable on the dependent variable to determine whether the independent variable partially has a significant effect or not on the dependent variable. The degree of error (α) used is 5% or significant 0.05 (Sugiyono, 2014).

a. If sig. t 0.05 then soybean prices, corn prices, population, income, number of industries for consumption and number of industries for animal feed partially have a significant effect on soybean demand.

b. If sig. t 0.05 then soybean prices, corn prices, population, income, number of industries for consumption and number of industries for animal feed partially have no significant effect on soybean demand.

**2.3 Elasticity Test**

The value of the elasticity test can be known by looking at the regression coefficient value of each independent variable. The elasticity value can be obtained by multiplying the coefficient b by the average X of each variable divided by the average Y which is obtained through the following formula:

$$E = bx \frac{X \text{ rata}-\text{rata}}{Qd \text{ rata}-\text{rata}}$$

Information:

  E      : Elasticity of demand
  b     : Variable regression coefficient
  X average    : Variable mean
  Qd average    : Average soybean demand

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**Table 1**Criteria of elasticity to the effect of price (Price Elasticity)

| | | |
|---|---|---|
| E = 0 | Perfectly inelastic | Demand does not change but there is a percentage change in price. |
| 0 < E < 1 | inelastic | Demand changes by a smaller percentage than price changes. |
| E = 1 | Unitary elasticity | Demand changes equal to the percentage change in price. |
| 1< E < ~ | Elastic | Demand changes by a greater percentage than price changes. |
| E = ~ | Perfect elasticity | Demand changes but there is no percentage change in price. |

**Table 2**Cross elasticity criteria

| | | |
|---|---|---|
| Positive E | Substitute goods | The percentage increase in corn prices resulted in increased demand for soybeans. |
| E Negative | Complementary goods | The percentage increase in corn prices resulted in a decrease in soybean demand. |

**Table 3**Income elasticity criteria

| | | |
|---|---|---|
| E > 0 | Normal goods | The percentage of soybean demand will increase if income increases. |
| E > 1 | luxury goods | The percentage of soybean demand will increase if income is very high. |
| E < 0 | inferior goods | The percentage of soybean demand will decrease if income increases. |

## 3. RESULTS AND DISCUSSION
### 3.1 Classical Assumption Test
1. Normality test

The results of the normality test can be seen in the image below.
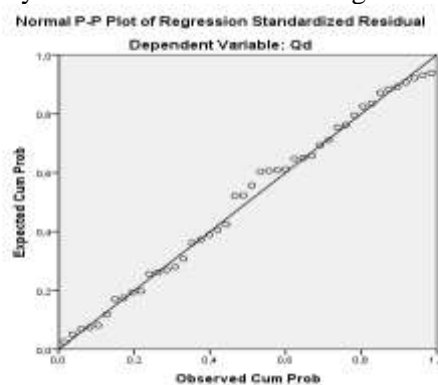


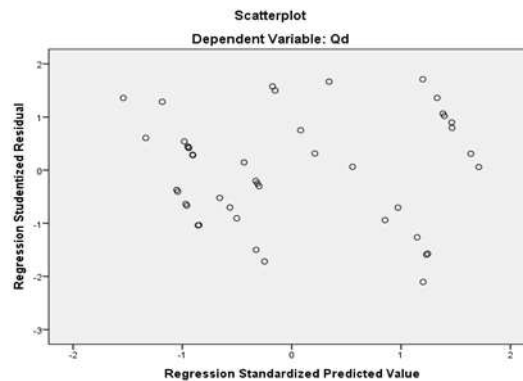**Figure 2** Normal Probability Plot Graph

Figure 2 illustrates that this study has met the assumptions, the residuals in the regression model in this study are normally distributed because they follow a diagonal line (Gujarati, 2003).
2. Heteroscedasticity Test

As for the results of the testheteroscedasticity in this study can be seen in the image below.

**Figure 3** Scatter Plot Chart

In Figure 3 it can be seen that rThe residual in the regression model in this study does not occur heteroscedasticity (expected) because there are no dots forming a clear pattern, but the dots spread irregularly.

3. Multicollinearity Test

The results of multicollinearity testing can be seen in the following table:

**Table 4** Multicollinearity Assumption Test Results on X1 to X6

| Variable | Collinearity Statistics | Information |
|---|---|---|
| | **VIF tolerance** | |
| (1) | (2) | (3) |
| Soybean Price | 0.121 8.233 | Non Multicollinearity |
| Corn Price | 0.189 5.295 | Non Multicollinearity |
| Total population | 0.105 9.496 | Non Multicollinearity |
| Income per capita | 0.102 9,790 | Non Multicollinearity |
| Number of Industries for consumption | 0.554 1.805 | Non Multicollinearity |
| Number of Industries for Feed | 0.221 4,530 | Non Multicollinearity |

Source: Secondary Data (processed) 2018

Based on Table 4, it can be seen from the tolerance value that is greater than or equal to 0.1 or the VIF value which is smaller or equal to 10 from each variable. Soybean prices (X1), corn prices (X2), population (X3), income per capita (X4), number of industries for consumption (X5) and number of industries for animal feed (X6) each have a greater tolerance value. or equal to 0.1 and VIF value less than or equal to 10. From these results it can be concluded that there is no multicollinearity in the regression model equation in this study.

4. Autocorrelation Test

The results of the autocorrelation test can be seen in the table below:

**Table 5** Durbin-Watson Autocorrelation Assumption Test

| Model | R | R square | Adjusted R Square | Durbin-Watson |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| | 0.958 | 0.918 | 0.905 | 1.304 |

Source: Secondary Data (processed) 2018

Based on Table 12, the Durbin-Watson (DW) value is 1.304. So that the Durbin-Watson (DW) value is between -2 and 2, meaning that it can be concluded that there is no autocorrelation between the confounding error in period t and the confounding error in the previous period.

## 3.2 Statistical Test

**Table 6** Result of Analysis of Factors Affecting Demand for Soybeans in North Sumatra Province

| Variable | Coefficient Regression | T | Sig |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| *(Constant)* | -8016, 679 | -2.892 | 0.006 |
| Soybean Price (X1) | -0.111 | -1,976 | 0.056 |
| Corn Price (X2) | -0.202 | -3,446 | 0.001 |
| Total Population (X3) | 0.016 | 5.072 | 0.000 |
| Income per Capita (X4) | 0.001 | 5,427 | 0.000 |
| Number of Industries for Consumption (X5) | 40,673 | 2,721 | 0.010 |
| Number of Industries for Feed (X6) | -27,741 | -0.336 | 0.739 |
| R | 0.958 | | |
| R2 | 0.918 | | |
| F Uji test | 69,300 | | |
| Sig F | 0.000 | | |

Source: Secondary Data (processed) 2018

Table 6 shows that the models used to estimate the effect are:

Qd =-8016.679- 0.111X1 - 0.202X2 + 0.016X3 + 0.001X4 + 40,673 X5-27,741X6

1. Correlation coefficient

The results of the analysis show an R value of 0.958 which indicates a positive relationship and the variables of soybean prices, corn prices, population, per capita income, number of industries for consumption, and the number of industries for animal feed with soybean demand are very strongly related.

2. Coefficient of Determination (R2)

The results of the analysis show the coefficient of determination is 0.918 or equal to 91.8%. The percentage of the influence of soybean prices, corn prices, population, per capita income, number of industries for consumption and the number of industries for animal feed on soybean demand is 91.8%. The remaining 8.2% is influenced by other variables outside the model that are not included in this study.

3. Simultaneous Test (F Test)

The results of the calculation of multiple linear regression analysis using SPSS can be seen in Table 6, the magnitude of Fcount is 69.300 with a significant value of 0.00 which is smaller than the value of (α) 0.05. This means that simultaneously soybean prices, corn prices, population, per capita income, number of industries for consumption, and number of industries for animal feed have a significant effect on soybean demand in North Sumatra Province.

4. Partial Test (t Test)

The results of the partial test scores from multiple linear regression analysis are as follows:
1. Soybean Price

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Based on the results of multiple linear regression analysis in Table 6, the significant value of soybean prices (X1) is 0.056, which is greater than the value ($\alpha$) of 0.05, which means that partially soybean prices have no significant effect on soybean demand (Qd). The number of industrial players who use soybean raw materials in North Sumatra Province makes soybean demand in this area quite high, but soybean production is not sufficient to meet soybean needs, especially for industrial producers, so the government imports soybeans. North Sumatra Province. Meanwhile, for soybean prices in North Sumatra Province, there is a government policy in supplying the availability of soybeans and the determination of soybean prices at the consumer level has been generally determined so that soybean prices are stable in the market so as to ensure the availability of soybeans for households to be consumed directly and also for industries that are used as raw materials. raw materials to create derivative products from soybeans. This is also a factor that does not affect the price. So that the effect of high and low soybean prices does not significantly affect the demand for soybeans in North Sumatra Province. This is also a factor that does not affect the price. So that the effect of high and low soybean prices does not significantly affect the demand for soybeans in North Sumatra Province. This is also a factor that does not affect the price. So that the effect of high and low soybean prices does not significantly affect the demand for soybeans in North Sumatra Province.

While the value of the soybean price coefficient of -0.111 means that if the price of soybeans increases by Rp. 1000, the demand for soybeans will decrease by 111 tons. This is in accordance with the theory of the law of demand that if the price of goods is lower, the demand will be more and if the price of goods is higher, the demand will be lower.

2. Corn Price

Based on the results of multiple linear regression analysis in Table 6, the significant value of corn prices (X2) is 0.001 smaller than the value ($\alpha$) of 0.05 which means that partially corn prices have a significant effect on soybean demand (Qd). This is acceptable because if corn is used as a substitute for soybeans, the effect of corn prices is very influential on demand for soybeans, when corn prices rise, demand for corn decreases and demand for soybeans increases because consumers will look for substitute goods from corn, one of which is soybean which is the same -same food crops either for consumption or feed according to consumer needs. However, in Sumatra Province in general, corn is used as a complementary product for soybeans because in this area the number of industries is high, viewed from the side of the consumption industry, if soybeans are used as tempeh crackers, tofu, tempeh then corn rice is used as a complement. However, viewed from the side of the animal feed industry, soybean and corn commodities are both used as feed even though corn is more dominantly used. This will be able to cause the effect of falling corn prices to increase soybean demand in North Sumatra Province.

The value of the corn price regression coefficient is -0,202, meaning that if the corn price increases by Rp. 1000, the demand for soybeans will decrease by 202 tons. This is because soybeans are complementary goods or complements to corn which are mostly used for animal feed.

3. Total population

Based on the results of multiple linear regression analysis in Table 6, the significant value of population t (X3) is 0.000, which is smaller than the value ($\alpha$) 0.05, which means that partially the population has a significant effect on soybean demand (Qd). This means that the population is directly proportional to the demand for soybeans in North Sumatra Province.

The regression coefficient value of the population of 0.016 means that if there is an increase of 100 people in the population, the demand for soybeans will increase by 1.6 tons. It is explained that one of the demand factors is population. The increase in population will increase the amount of demand in an area because the more the population needs for an item. Therefore, the increase in population will affect the demand for soybeans in North Sumatra Province.

4.  Income per capita

Based on the results of multiple linear regression analysis in Table 6, the significant value of t income per capita (X4) is 0.000 which is smaller than the value (α) of 0.05 which is means that partially per capita income has a significant effect on soybean demand (Qd). This is because the level of consumer income is very influential on consumer purchasing power, if there is a change in income it will cause changes in consuming various types of goods, especially foodstuffs, if income increases then consumption will increase for food, one of which is soybeans which can be processed into foodstuffs such as tofu, tempeh, soy sauce, soy milk and other preparations that are in great demand by residents of North Sumatra Province. The income regression coefficient value of 0.001 means that if there is an increase in income of Rp. 100,000, the demand for soybeans will increase by 100 tons.

5.  Number of Industries For Consumption

Based on the results of multiple linear regression analysis in Table 6, the significant value of t for the number of industries for consumption (X5) is 0.010 less than the value (α) 0.05, which means that partially the number of industries for consumption has a significant effect on soybean demand (Qd). The number of industries for consumption made from soybeans in North Sumatra Province is very high, due to high consumption of tofu and tempeh as foods that provide protein to the body, this is what causes the number of consumption industries to greatly affect the demand for soybeans in North Sumatra Province.

While the regression coefficient value for the number of industries for consumption is 40,673 which means that if there is an increase in the number of industries for consumption by 1 unit, the demand for soybeans will increase by 40,673 tons. This is due to the large number of processed food industries made from soybeans and the high public awareness in meeting protein. In North Sumatra Province, almost 85% of soybeans are used for the manufacture of food ingredients such as tempeh, tofu, soy sauce, soy milk, flour and so on.

6.  Number of Industries For Animal Feed

Based on the results of multiple linear regression analysis in Table 6, the significant value of t number of industries for animal feed (X6) is 0.739 greater than the value (α) 0.05 which means that the independent variable number of industries for animal feed partially has no significant effect on soybean demand. (Qd). This is acceptable because the number of industries for animal feed in North Sumatra Province is much lower than the number of industries for consumption. In addition, the soybean commodity in North Sumatra Province when viewed from the side of its use for the animal feed industry is only used as a complementary item, the most important commodity for the animal feed industry is corn.

The regression coefficient value of the number of industries for animal feed is -27.741 which means that if there is an increase in the number of industries for animal feed by 1 unit, the demand for soybeans will decrease by 27.741 tons. The decline in soybeans is not absolutely caused by an increase in the animal feed industry, but the meaning of the decrease in soybean demand is only for producers of the animal feed industry who buy soybeans in smaller quantities as a result of the increase in producers of new feed industries, thereby reducing the demand for old feed industry producers. .

**3.3 Elasticity Test**

**Table 7** The Elasticity of Soybean Demand in North Sumatra Province

| Regression Coefficient (b) | X Average | Qd Average | Elasticity |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| -0.111 (X1) | 5,961 (X1) | 9,653,363 | -0.068 |

| | | |
|---|---|---|
| -0.202 (X2) | 5833 (X2) | -0.122 |
| 0.016 (X3) | 1,095,055 (X3) | +7.089.85 |
| 0.001 (X4) | 1,345,958 (X4) | +0.139 |
| 40,673 (X5) | 39,454 (X5) | +0.166 |
| -27,741 (X6) | 8.45 (X6) | -0.024 |

Source: Secondary Data (processed) 2018

The results of the analysis of the elasticity of demand for soybeans, namely price elasticity, cross elasticity and income elasticity in North Sumatra Province can be seen in the following table:

**Table 8** The Value of Soybean Demand Elasticity in North Sumatra Province

| Variable | Elasticity | | |
|---|---|---|---|
| | Price | Cross | Income |
| (1) | (2) | (3) | (4) |
| Soybean price (X1) | -0.068 | - | - |
| Corn price (X2) | - | -0.122 | - |
| Revenue (X4) | - | - | +0.139 |

Source: Secondary Data (processed) 2018

The value of the elasticity of demand in Table 8 can be explained as follows:
1. Price elasticity (soybean demand to soybean price)
Based on the results of the analysis, it can be seen that the price elasticity of soybean is -0.068 and this value is less than one, so it is inelastic. The elasticity value is negative in this case shows that the soybean price variable has an inverse relationship with soybean demand. It means If the price of soybeans increases by 1%, the demand for soybeans will decrease by 0.068%. This means the percentage change in demand is less than the percentage change in price.

2. Cross elasticity (soybean demand to corn price)
Based on the results of the analysis, it can be seen that the magnitude of the cross elasticity of the corn price is -0.122. This means that if the price of corn increases by 1%, the demand for soybeans will decrease by 0.122%. The negative sign on the elasticity value indicates that corn is a complementary good.

3. Income elasticity (soybean demand to income)
Based on the results of the analysis, it is known that the income elasticity is 0.139. This means that if income increases by 1%, the demand for soybeans will increase by 0.139%. The elasticity value is greater than zero, then this also shows that soybeans are normal goods and have a positive sign, meaning that if the income of the population increases, the demand for soybeans will increase.

## 4. CONCLUSION

Simultaneously, soybean prices, corn prices, population, income, number of industries for consumption and number of industries for animal feed have a significant effect on soybean demand in North Sumatra Province. Partially the price of corn, population, per capita income, the number of industries for consumption have a significant effect on soybean demand in North Sumatra Province, while partially soybean prices, the number of industries for animal feed have no significant effect on soybean demand in North Sumatra Province. Soybean price elasticity is

less than one, so it is inelastic. The cross elasticity of corn prices is negative, meaning that corn is a complementary good for soybeans. Income elasticity per capita is greater than zero and is positive, this indicates that soybean is a normal good.

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