# Factors Affecting Soybean Demand in North Sumatra

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A R T I CLEINFO

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A B STR A K

Soybean is one of the main food commodities after rice and corn. Soybean with other names Glycine max (yellow soybean); Glycinesoja (black soybean) is a versatile plant. Its roots have free nitrogen-fixing nodules. Soybean is a plant with high protein content so that the plants can be used as green manure and animal feed. The main utilization of soybean is from its seeds. Soybean seeds are rich in protein and fat as well as several other important nutritional ingredients, such as vitamins (phytic acid) and lecithin. Indonesia's soybean demand continues to increase from year to year, due to population growth and changes in food patterns in line with economic growth. The increase in population in North Sumatra Province directly affects the growth of food demand. The need for soybeans in North Sumatra Province continues to increase, triggered by the increasing number of small food industries made from these commodities (Waspada, 2012). Soybeans in North Sumatra Province have been developed since the New Order era. Soybean commodity development is centered in several districts including Deli Serdang, Langkat, and South Tapanuli (BPS, 2015). Development of harvest area, total production and average soybean production in North Sumatra Province in the last 10 years.

## INTRODUCTION

The most important basic human need and its fulfillment is part of the human rights guaranteed in the 1945 Constitution of the Republic of Indonesia is food. According to the Ministry of Health (2005), the fulfillment of food needs is also related to efforts to improve the quality of public health so as to obtain the quality of Indonesian resources that have strong and superior competitiveness as a nation. Quality human resources are described as healthy people who are intelligent, productive and independent. Therefore, the demand for food consumption will continue to increase from year to year along with population growth.

Other factors that cause food demand to continue to increase are increasing income, increasing purchasing power and awareness of the importance of nutritional value (carbohydrates, protein, vitamins) of food consumed. One of the government's efforts is through food and nutrition diversification. The food diversification program has actually been initiated since the beginning of the 60s decade, where the government

has realized the importance of diversification. The program is one of the four main programs of agricultural development, namely, through food diversification both from plants, livestock and fish to meet the needs of carbohydrates, protein, fat, vitamins and minerals (Aminatadisastro, 1997).

## METHODOLOGY

### Research Area Determination Method

The research was conducted in North Sumatra Province. North Sumatra Province was chosen as the research location because this area is one of the provinces with the highest soybean demand in Indonesia but one of the lowest soybean producing provinces in Indonesia (BPS, 2019). In addition, the location is also very representative in terms of access and opportunities to obtain the data desired by researchers.

### Data Determination Method

The data used in this study are secondary data, in the form of annual time series data from 1990 - 2019, so that 30 observations are obtained. Secondary data is primary data that has been processed and presented in tables and in other forms (Umar, 2008). Secondary data were obtained from the North Sumatra Central Bureau of Statistics, North Sumatra Agriculture Office, North Sumatra Livestock Service Office, Food Security and Horticulture Agency, research results, journals, literature, and other related agencies.

### Data Collection Methods

The data collected in this study were obtained and published by the Central Statistics Agency (BPS) of North Sumatra Province, the Food Crops and Horticulture Office of North Sumatra Province and other relevant agencies, and the data were also taken from books related to soybean demand.

### Data Analysis Method

To answer the problem identification, this study uses data analysis methods that explain the effect of independent variables on the dependent variable. Soybean demand in North Sumatra Province is the dependent variable (Y), while the independent variables are current year soybean prices (X1), current year corn prices (X2), previous year soybean prices lag t-1 (X3) and previous year corn prices lag t-1 (X4). The data used in this study is quantitative data in the form of secondary data, which is data published by the Central Bureau of Statistics of North Sumatra Province.

**Multiple Linear Regression**

The method of analysis used in this study is to use quantitative analysis methods, namely analytical methods based on calculations with the following equation (Nachrowi.2002: 121)

$$Y = b0 + b1\ X1 + b2X2 + b3X3 + b4X4 + e$$

Where:

Y = Dependent Variable
X1 = Independent Variable
X2 = Independent Variable
X3 = Independent Variable
X4 = Independent Variable
e = Standard Error
1,2,3 = Number of observations ,,,, N (number of observations)
b0,b1,b2,b3 = Regression Coefficient

In this study the equation using the distributed lag model is used as follows:

$$Y = b0 + b1\ X1 + b2X2 + b3X3lag\ t\text{-}1 + b4X4lag\ t\text{-}1 + e$$

Where:

Y = Demand for North Sumatra soybeans
b0 = Constant
b1,b2,b3,b4 = Regression Coefficient
X1 = Current year soybean price
X2 = Current year corn price
X3lag t-1 = Previous year soybean price
X4lagt-1 = Previous year corn price
e = Standard Error

This test is conducted to see the effect of independent variables in this model on the dependent variable, to see and know how much influence soybean prices and corn prices have on soybean demand in North Sumatra Province. The reasons for using multiple linear regression models with distributed lag models in this study are (Supranto, 2004: 131).

1. Time lag is a model because among the independent variables there are one or more lagged dependent variables.
2. Often the reaction of Y to the effect of variable X takes time. The time required for a reaction or response to an action or effect is called a time difference or lag.

**F-Test**

Hypothesis testing of regression coefficients carried out as a whole is used to determine whether each variable simultaneously has a positive influence or not on the dependent variable by testing the hypothesis as follows:

- Ho: b1: b2: b3 = 0; there is no influence between the independent variables on the dependent variable
- Ha: b1: b2 or b3≥ 0; there is at least one independent variable that affects the dependent variable.

With the test criteria, namely:

- Ho is accepted, if ≤ fcount ≤ ftabel
- Ho is rejected, if fcount ≥ ftabel

**Pengujian Hipotesis**

Hypothesis test (t-test)

Used to determine the effect between the independent variable and the dependent variable individually with hypothesis testing as follows:

- Ho: bi = 0; then there is no influence between the variables of soybean prices and corn prices on the demand for soybeans in North Sumatra Province.
- Ha: bi≠ 0; then there is an influence between the variables of soybean prices and corn prices on the demand for soybeans in North Sumatra Province.

With the test criteria are:

- Ho is accepted, if - t table ≤ t count ≤ t table
- Ho is rejected, if t count < - t table or t count> t table

In addition to being seen using the value of t count and t table can be done by comparing the prob value and α.

1. Ho is accepted, if the prob value> α. This means that the independent variable has no effect on the independent variable.
2. Ho is rejected, if the prob < α, this means that the independent variable has an effect on the independent variable.

In this paper, the test carried out is a 2-way test with α = 5%. The test carried out is a 2-way test so that the α used is α / 2 so that α = 0.025

**Multiple coefficient of determination (R2)**

The coefficient of multiple determination is used to measure the amount of reduction in the variability of Y obtained by using the independent variables X1, X2, X3 lag t-1, and X4 lag t-1 to determine the magnitude of the influence of independent

variables on changes in the rise and fall of the dependent variable (Y) so that the coefficient of determination (R2) is used and as a whole using the correlation coefficient (R).

**Classical Assumption Test**

This classic assumption test uses SPSS 25 software.

a. Multicollinearity Test

This multicollinearity test is used to show the existence of a linear relationship between the independent variables in the regression model, showing the relationship between the soybean price and corn price variables in the regression method. In this test, if the soybean price and corn price variables are perfectly correlated, it is called "perfect multicollinearity". The use of the word multicollinearity is intended to indicate a high degree of collinearity among the independent variables. If the soybean price and corn price variables are perfectly correlated then the least squares method cannot be used.

Multicollinearity problems can arise for various reasons (Sumodinigrat, 2003: 282) including:

1. The properties contained in most economic variables change together over time.
2. The use of lagged values of certain independent variables in the regression model.

According to Setyadharma (2010: 8) to see the multicollinearity problem can be done by doing the VIF test and if the value of the VIF test results has a value greater than 10 then the equation is indicated to have a multicollinearity problem. In addition, to see if there is a multicollinearity problem, namely:

1. Seeing the high R2 value (significant), but the standard error value and the significance level of each variable are very low.

b. Autocorrelation Test

The autocorrelation test with the previously developed regression model assumes that the model error components are uncorrelated random variables (Douglas and William, 1990: 499). In detecting the presence or absence of autocorrelation in the model equation carried out, it can be known by doing the Durbin Watson test. Then the Durbin Watson value is compared with the dtabel value. The comparison results will produce conclusions such as the following criteria (Setyadharma, 2010: 4):

1) if DW is between dl and 4-dl, it means there is no autocorrelation.
2) If DW < dl it means there is positive autocorrelation
3) If DW is between dl and du, it means that it cannot be concluded.
4) if DW> dl means there is positive autocorrelation

c. Heteroscedasticity

An important assumption in classical linear regression models is that the confounding error ε1 has the same variance, meaning Var (ε1) = E(ε 2 i) =σ 2 for all i, i = 1, 2, … n. This assumption is called HOMOSCEDASTIC (homoscedastic) (Supranto.2004: 46). To detect the presence of heteroscedasticity problems can be done by doing the Glejser test. Glejser test is done by making a regression between the logarithm of squared residuals as the dependent variable with the logarithm of the independent variable then the t-test is done to see the significance of the resulting coefficient, if the t-test results show significant results this indicates that there is heteroscedasticity and vice versa if the t-test results are not significant it means there is no heteroscedasticity (Narchowi.2002: 163).

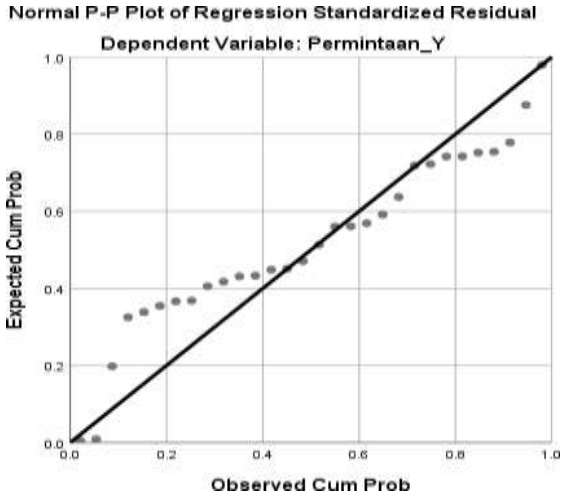
## RESULTS AND DISCUSSION

### Factors Affecting Soybean Demand in North Sumatra Province

From the data analysis method, it is known that the variables that can affect soybean demand in North Sumatra Province are the current year soybean price (X1), current year corn price (X2), previous year soybean price (X3) and previous year corn price (X4). From these independent variables, it will be seen how much influence it has on the demand for soybeans as the dependent variable (Y). However, before conducting the regression analysis, the classical assumption test must first be fulfilled, namely:

### Normality Test

The normality test can be seen from the scatterplot graph of the processing results with SPSS as follows.




Gambar 3.1. Normal Plot of Soybean Demand

In figure 3.1. It can be seen that the normal probability plot graph shows a normal graph pattern. This can be seen from the points that spread around the normal graph and the distribution follows the diagonal line.

**Multiple Linear Regression Analysis**

Soybean demand is influenced by variables such as Soybean Price (X1), and Corn Price (X2). From these independent variables, it will be seen how much influence it has on the demand for soybeans as the dependent variable (Y). The results of multiple linear regression can be seen in table 3.1. Table 3.1 shows the following.

**Tabel 1. Hasil Analisis Regresi Linier Berganda Permintaan (unlagged) Kedelai di Provinsi Sumatera Utara**

| Variabel | Koefisien Regresi | T Hitung | Signifikan |
|---|---|---|---|
| (Constant) | 324739.942 | 31.554 | 0.000 |
| Harga Kedelai (X1) | 0.012 | 2.463 | 0.020 |
| Harga Jagung (X2) | 0.021 | 2.192 | 0.037 |
| $R^2$ | 0.812 | | |

Sumber: Analisis data sekunder dari lampiran 2 (diolah)

Dari tabel 3.1. diatas diperoleh persamaan regresi sebagai berikut:

$$Yt = 324739.942 + 0.012X1 + 0.021\ X2$$

Keterangan :

Yt = Permintaan Kedelai (Ton)
X1 = Harga Kedelai (Rp/Ton)
X2 = Harga Jagung (Rp/Ton)
b1-b2 = Koefisien variable Regresi

From the data analysis above, it is known that the p-value (sig) of X1 is 0.020. Since the p-value of 0.020 < α = 0.05, it can be concluded that the price of soybean (X1) has a significant effect on the demand for soybean (Y). The p-value (sig) of corn price X2 is 0.037 < α = 0.05, it can be concluded that the price of corn (X2) is significant to the demand for soybeans in North Sumatra Province.

From table 3.1. The R2 value of 0.812 is obtained, which means that 81.20% of the variation of the dependent variable, namely the demand for soybeans, can be explained by the variation of the independent variables, namely the price of soybeans and the price of corn, while the remaining 18.80% is explained by other variables that are not included in the model.

**Analisis Distributed Lagt-1**

Soybean demand is influenced by variables such as current year soybean price (X1), current year corn price (X2), lagt-1 soybean price and lagt-1 corn price. From these independent variables, it will be seen how much influence they have on soybean demand as the dependent variable (Yt). The results of multiple linear regression can be seen in table 3.2. The following:

**Tabel 2. Hasil Analisis Regresi Linier Berganda Permintaan Kedelai Lagt-1 di Provinsi Sumatera Utara**

| Variabel | Koefisien Regresi | T Hitung | Signifikan |
|---|---|---|---|
| (Constant) | 325111.215 | 30.997 | 0.000 |
| Harga Kedelai tahun sekarang (X1) | 0.009 | 1.685 | 0.105 |
| Harga Jagung tahun sekarang (X2) | 0.009 | 0.839 | 0.410 |
| Harga kedelai lagt-1 | 0.003 | 0.493 | 0.626 |
| Harga jagung lagt-1 | 0.014 | 1.426 | 0.167 |
| $R^2$ | 0.834 | | |

Sumber: Analisis data sekunder dari lampiran 3 (diolah)

Dari tabel 5.2. diatas diperoleh persamaan regresi sebagai berikut:

Yt = 325111.215+ 0.009 X1 +0.009 X2 + 0.003X1 lagt-1 + 0.014 X2lagt-1

Keterangan:

Yt = Permintaan Kedelai (Ton)
X1 = Harga Kedelai tahun sekarang (Rp/Ton)
X2 = Harga Jagung tahun sekarang (Rp/Ton)
X1lagt-1 = Harga kedelai tahun sebelumnya (Rp/ton)
X2lagt-1 = Harga jagung tahun sebelumnya (Rp/ton)
b1-b4 = Koefisien variable Regresi

From the data analysis above, it is known that the p-value (sig) of X1 is 0.105. Since the p-value of 0.105 > α = 0.05, it can be concluded that the current year's soybean price (X1) has an insignificant effect on soybean demand (Yt). For the p-value (sig) of the current year's corn price (X2) 0.410 > α = 0.05, the previous year's soybean price lagt-1 0.626 > α = 0.05 and the previous year's corn price lagt-1 0.167 > α = 0.05, it can be concluded that the current year's corn price, the previous year's soybean price lagt-1 and the previous year's corn price lagt-1 are not significant to the demand for soybeans in North Sumatra Province. From table 3.2. The R2 value of 0.834 is obtained, which means that 83.40% of the variation in the dependent variable, namely the demand for soybeans, can be explained by variations

in the independent variables, namely the current year's soybean price, the current year's corn price, the previous year's soybean price and the previous year's corn price, while the remaining 16.60% is explained by other variables that are not included in the model.

**Analisis Distributed Lagt-2**

Soybean demand is influenced by variables such as current year soybean price (X1), current year corn price (X2), lagt-1 soybean price, lagt-1 corn price, lagt-2 soybean price and lagt-2 corn price. From these independent variables, it will be seen how much influence they have on soybean demand as the dependent variable (Yt). The results of multiple linear regression can be seen in table 3.3. The following:

**Tabel 3. Hasil Analisis Regresi Linier Berganda Permintaan Kedelai Lagt-2 di Provinsi Sumatera Utara**

| Variabel | Koefisien Regresi | T Hitung | Signifikan |
|---|---|---|---|
| (Constant) | 328260.637 | 28.934 | 0.000 |
| Harga Kedelai tahun sekarang (X1) | 0.007 | 1.279 | 0.215 |
| Harga Jagung tahun sekarang (X2) | 0.001 | 0.083 | 0.934 |
| Harga kedelai lagt-1 | 0.004 | 0.686 | 0.500 |
| Harga jagung lagt-1 | 0.005 | 0.484 | 0.633 |
| Harga kedelai lagt-2 | 0.000 | 0.053 | 0.959 |
| Harga jagung lagt-2 | 0.017 | 1.524 | 0.142 |
| $R^2$ | 0.844 | | |

Sumber: Analisis data sekunder dari lampiran 4 (diolah)

From the regression analysis above, the following equations are obtained:

Yt = 328260.637 + 0.007X1+0.001X2+0.004X1 lagt-1+0.005X2 lagt-1+0.000X1 lagt-2+0.017X2 lagt-2

Description:

| | |
|---|---|
| Yt | = Soybean Demand (Tons) |
| X1 | = Current year Soybean Price (Rp/Ton) |
| X2 | = Current year Corn Price (Rp/Ton) |
| X1lagt-1 | = Previous year soybean price (Rp/ton) |
| X2lagt-1 | = Previous year corn price (Rp/ton) |
| X1lagt-2 | = Previous year soybean price (Rp/ton) |
| X2lagt-2 | = Previous year corn price (Rp/ton) |
| b1-b6 | = Coefficient of Regression variable |

From the data analysis above, it is known that the p-value (sig) of X1 is 0.215. Since the p-value of 0.215 > α=0.05, it can be concluded that the current year's soybean price (X1) has an insignificant effect on soybean demand (Yt). For the p- value (sig) of current year corn price (X2) 0.934 > α = 0.05, previous year soybean price lagt-1 0.500 > α = 0.05 and previous year corn price lagt-1 0.633 > α = 0.05, previous year soybean price lagt-2 0. 959 > α = 0.05 and the price of corn 2 years earlier lagt-2 0.142 > α = 0.05, it can be concluded that the current year's corn price, the previous year's soybean price lagt-1, the previous year's corn price lagt-1, the previous year's soybean price lagt-2, and the previous year's corn price lagt-2, are not significant to the demand for soybeans in North Sumatra Province.

From table 3.3. The R2 value of 0.844 is obtained, which means that 84.40% of the variation in the dependent variable, namely the demand for soybeans, can be explained by the variation in the independent variables, namely the current year's soybean price, the current year's corn price, the previous year's soybean price, the previous year's corn price, the soybean price 2 years earlier and the corn price 2 years earlier, while the remaining 15.60% is explained by other variables that are not included in the model.

**Analisis Distributed Lagt-3**

Soybean demand is influenced by variables such as current year soybean price (X1), current year corn price (X2), lagt-1 soybean price, lagt-1 corn price, lagt-2 soybean price, lagt-2 corn price, lagt-3 soybean price and lagt-3 corn price. From these independent variables, it will be seen how much influence they have on soybean demand as the dependent variable (Yt). The results of multiple linear regression can be seen in table 3.4.

**Tabel 4. Hasil Analisis Regresi Linier Berganda Permintaan Kedelai Lagt-3 di Provinsi Sumatera Utara**

| Variabel | Koefisien Regresi | T Hitung | Signifikan |
|---|---|---|---|
| (Constant) | 329809.372 | 29.511 | 0.000 |
| Harga Kedelai tahun sekarang (X1) | 0.009 | 1.700 | 0.106 |
| Harga Jagung tahun sekarang (X2) | 0.005 | 0.471 | 0.644 |
| Harga kedelai lagt-1 | 0.000 | -0.030 | 0.976 |
| Harga jagung lagt-1 | -0.004 | -0.311 | 0.759 |
| Harga kedelai lagt-2 | 0.002 | 0.364 | 0.720 |
| Harga jagung lagt-2 | -0.001 | -0.060 | 0.953 |
| Harga kedelai lagt-3 | -0.001 | -0.157 | 0.877 |
| Harga jagung lagt-3 | 0.027 | 2.555 | 0.020 |
| $R^2$ | 0.883 | | |

Sumber: Analisis data sekunder dari lampiran 5 (diolah)

From the regression analysis above, the following equations are obtained:

Yt = 329809.372+ 0.009X1+0.005X2+0.000X1 lagt-1 -0.004X2 lagt-1+0.002X1 lagt-2-0.001X2 lagt-2-0.001X1 lagt-3+0.027X2lagt-3

Description:

| | |
|---|---|
| Yt | = Soybean Demand (Tons) |
| X1 | = Current year Soybean Price (IDR/Ton) |
| X2 | = Current year Corn Price (IDR/Ton) |
| X1lagt-1 | = Previous year soybean price (IDR/ton) |
| X2lagt-1 | = Previous year corn price (IDR/ton) |
| X1lagt-2 | = Previous year soybean price (IDR/ton) |
| X2lagt-2 | = Previous year corn price (Rp/ton) |
| X1lagt-3 | = Previous year soybean price (Rp/ton) |
| X2lagt-3 | = Previous year corn price (Rp/ton) |
| b1-b8 | = Coefficient of Regression variable |

From the data analysis above, it is known that the p-value (sig) of the independent variables X1, X2, X1 lagt-1, X2 lagt-1, X1 lagt-2, X2 lagt-2 and X1 lagt-3 are > α = 0.05, it can be concluded that the variables of soybean prices and corn prices have an insignificant effect on soybean demand (Yt). As for the p-value (sig) of the price of corn 3 years earlier (X2 lagt-3) < α = 0.05, it can be concluded that the price of corn 3 years earlier lagt-3, has a significant effect on the demand for soybeans in North Sumatra Province.

From table 3.4. The R2 value of 0.883 is obtained, which means that 88.30% of the variation in the dependent variable, namely the demand for soybeans, can be explained by variations in the independent variables, while the remaining 11.70% is explained by other variables that are not included in the model.

(1) Yt = 325111.215+ 0.009 X1 +0.009 X2 + 0.003X1 lagt-1 + 0.014 X2lagt-1
(2) Yt = 328260.637 + 0.007X1+0.001X2+0.004X1 lagt-1+0.005X2 lagt-1+0.000X1 lagt-2+0.017X2 lagt-2
(3) Yt = 329809.372+ 0.009X1+0.005X2+0.000X1 lagt-1 -0.004X2 lagt-1+0.002X1 lagt-2-0.001X2 lagt-2-0.001X1 lagt-3+0.027X2lagt-3

It can be seen that until the formation of model (2), the sign of the coefficients is still "stable". Therefore, the data processing was continued to the next stage, resulting in equation (3). From the equation, it can be seen that the coefficient of the independent variable X1 lagt-3 is unstable, because in equation (2) the sign is positive, while in equation (3) it turns negative. So, the equation chosen as the Distributed Lag model is equation (2), namely:

(2) Yt = 328260.637 + 0.007X1+0.001X2+0.004X1 lagt-1+0.005X2 lagt-1+0.000X1 lagt-2+0.017X2 lagt-2

From the coefficients in the equation above, it is known that soybean prices and corn prices at that time have a higher influence than other independent variables (soybean prices and corn prices in the previous year) in determining the size of soybean demand in North Sumatra Province. In addition, from the coefficients in the above equation, it can be seen as follows:

1. The regression coefficients on variables X1 and X2 are positive, meaning that the relationship between current soybean demand and current soybean prices and current corn prices is unidirectional or positive. The higher the price of soybeans in the current year, and the price of corn in the current year, the greater the demand for soybeans in the current year.
2. The regression coefficient on variables X1 lagt-1 and X2 lagt-1 is positive, meaning that the relationship between current year soybean demand and soybean prices and corn prices 1 year earlier is unidirectional or positive. The higher the price of soybeans and the price of corn 1 year earlier, the greater the demand for soybeans in the current year.
3. The regression coefficient on variables X1 lagt-2 and X2 lagt-2 is positive, meaning that the relationship between current year soybean demand and soybean prices and corn prices 2 years earlier is unidirectional or positive. The higher the price of soybeans and the price of corn 2 years earlier, the greater the demand for soybeans in the current year.

## CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the analysis in this study, the following conclusions can be drawn Soybean and corn prices have a positive effect on soybean demand in North Sumatra Province in the current year, the previous year, and the year before that (distributed lagged).

The recommendations proposed in this study are as follows:

1. The government needs to increase local soybean production to address the gap between demand and the annual population growth.
2. Future researchers are advised to conduct further research on other variables that affect soybean demand in North Sumatra Province.

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