Analysis of Corn Supply in North Sumatra Province

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ABSTRACT

Knowledge of the magnitude of the influence of factors that affect supply can be used to estimate the amount of corn supply. Corn in North Sumatra Province also has an important role for the government, corn producers, and corn consumers. The availability of planting land, production and prices of corn that always change every year, this will affect the supply of corn in North Sumatra Province. The purpose of this study was to analyze the effect of maize prices in year t, maize prices in the previous year, maize harvested area, and urea fertilizer prices on maize supply in North Sumatra Province and analyze the short-term and long-term supply elasticity of maize in North Sumatra Province. The research method used is distributed lagmodel analysis. The results of this study are the price of corn the previous year (P_{jt-1}) with a probability value of 0.0143 and the area of harvest (L_{pj}) with a probability value of 0.0130 have a significant effect on corn supply in North Sumatra Province (S_{jt}). While the price of corn in year t (P_{jt}) with a probability value of 0.8511 and the price of urea fertilizer (H_{pu}) with a probability value of 0.2764 did not significantly affect the supply of corn in North Sumatra Province. The short-term elasticity is $0.050244 < 1$, which means that every 1% change in the price of corn will increase the supply of corn by 0.05% and in the long run $0.706585 < 1$, which means that every 1% change in the price of corn will increase the supply of corn by 0.71% is inelastic to the supply of corn in North Sumatra Province.

Keywords: Elasticity, Corn and Supply

BACKGROUND

Currently, the fulfilment of basic food needs in various regions in Indonesia relies on rice. Therefore, Indonesia must diversify its food. The business prospect of another leading crop commodity is corn because it is one of the main food crop commodities that have a strategic role in the development of agriculture and the Indonesian economy, considering that this commodity has multipurpose functions, both for direct consumption and as the main raw material for the feed industry and the food industry. Agency for Agricultural Research and Development, 2005) In Indonesia, corn has been known about 400 years ago and was imported by the Portuguese and Spanish. Corn production centres in Indonesia were initially concentrated in Central Java, East Java, and Madura. Domestic market demand and export opportunities for corn commodities tend to increase from year to year, both to meet food and non-food needs (Rukmana, 2008). The facts show that dependence on one type of carbohydrate weakens food security. Therefore, other carbohydrate sources based on local resources are needed. Local food is food produced in the local area for consumption and/or economic purposes. Thus, local food is food that is not imported. Corn is one type of food that has the potential to be developed as local food.

Based on data from the Indonesian Central Statistics Agency for 2015-2918 demand for corn in Indonesia in 2015-2018 fluctuated, the highest demand for corn in 2015 was 22,844,000 tons and the lowest

demand in 2017 was 4,615,000 tons, then increased again in 2018 amounted to 16,229,000 tons. Corn prices in Indonesia to 2015-to-2018 have increased every year with an average growth of 4.69% with an average price of IDR 4,169 per kilogram. Corn production centres in Indonesia from 2014 to 2018 were distributed in ten provinces with a total contribution of 85.36% of Indonesia's total production. And North Sumatra ranks fifth with a contribution of 6.38% of the ten corn production centres.

Corn in North Sumatra Province also has an important role for the government, corn producers, and corn consumers. Corn is useful in increasing food security, as a source of income for the North Sumatra provincial government, and as a source of income for producers. From a consumer point of view, corn is useful for consumption both directly and its derivative products, as well as animal feed, where the animal feed can increase livestock products such as meat and eggs that are needed by consumers.

Table 1: Corn Supply in North Sumatra Province 2010-2016

No.	Year	Supply (Ton)
1.	2010	1478564.81
2.	2011	1600463.86
3.	2012	1564207.05
4.	2013	1436637
5.	2014	1424813
6.	2015	1639944
7.	2016	1669837.8

Source: Central Bureau of Statistics of North Sumatera Province

The supply of corn in North Sumatra fluctuates every year, the highest supply occurred in 2016 amounted to 1669837.8 tons, and the lowest supply occurred in 2014 amounted to 1424813 tons. This fluctuation can be caused by several supply factors such as corn prices, corn harvested area, and other production factors. Knowledge of the magnitude of the influence of factors that affect supply can be used to estimate the amount of corn supply. About the government's obligation to meet the

domestic demand for maize, knowledge of the magnitude of the influence of factors affecting supply can be used to estimate developments. Supply information is important for making further policies, for example determining the number of imports, policies to increase harvested area, export plans, and others. The availability of planting land, production and prices of corn are always changing every year. This will affect the supply of corn in North Sumatra Province.

Supply

In economic terms, the term supply is generally known which means supply. Supply is the number of agricultural commodities offered by producers or sellers. Meanwhile, the law of supply states that the higher the price of an item, the more the quantity of that item will be offered by producers/sellers assuming other factors do not change (Daniel 2004).Supply is the amount of an item that is willing to be sold at various possible prices, within a certain period. Supply shows the amount (maximum) that will be sold at various price levels or several minimum prices that still encourage sellers to offer various quantities of an item (Hanafie R, 2010).

Product or service, more broadly the price is the sum of the values exchanged in the selling value of the product set by the company. This brings us to the law of supply, which explains the nature of the relationship between the price of a good and the quantity of that good that sellers offer. The law of supply states "The higher the price of an item, ceteris paribus, the more quantity the seller is willing to offer, and vice versa". If the price of an item rises (ceteris paribus) then the quantity supplied of the item will increase because producers hope to get a greater profit from the sale of the item, and vice versa, if the price of corn in the previous year increases, many farmers will grow corn, so that the results corn production increases and results increase supply (Hanafie, 2010). An increase in production can be caused by one of two

factors, namely area planted and yield per hectare, or both (Mubyarto, 1995).

The harvested area will affect the amount of corn produced. If the corn harvested area in a year increases, the quantity supplied will increase. The area of the harvested area is a factor that can affect the level of supply or the level of production of an item. If the area of a harvested area cannot meet the production of an item, then the goods produced cannot meet the number of requests demanded by the community. So harvested area is one of the main factors in meeting the production of an item offered. The costs incurred to obtain factors of production are very important expenditures in the production process. Urea fertilizer is used as one of the influencing inputs because the nitrogen content in urea is needed during corn growth in relatively large amounts, which is 400kg/ha. With the provision of fertilizer as a good input during growth, production will also increase so that the amount offered will also increase. The supply curve will shift to the right or the left if there is a change in supply caused by non-price factors.

The elasticity of the supply

The elasticity of supply is a number that shows what percentage of the quantity supplied of goods changes when the price of the good changes by 1%. The elasticity of supply can be related to other factors or variables that are considered to influence it, such as technology, production factor prices, harvested area and prices of other materials (Firdaus, 2008). The elasticity of supply states the level of sensitivity of the quantity supplied due to changes in the price of the agricultural product itself and changes in the price of other agricultural products. The price elasticity of supply measures how much the quantity supplied of good changes with changes in the price of that good. The supply of a good is said to be elastic if a change in the price of the good causes the quantity supplied to be large enough. On the other hand, supply is said to be inelastic or inelastic if the quantity supplied changes

only slightly when the price changes (Sudiyono, 2004). Increasing and decreasing agricultural production yields is much more difficult than increasing or decreasing industrial products which are all made in factories and are not tied directly to natural factors (Daniel, 2002).

Hapsari (2011) through his research entitled Analysis of Corn Supply in Grobogan Regency shows 88.6% of corn supply in Grobogan Regency can be explained by the variable price of corn in the previous year, the amount of corn production in the previous year, the area harvested in the year of planting, the price of urea in the previous year of planting and the average amount of rainfall in the year of planting. The elasticity of supply on the price of corn in the previous year in GroboganRegency in the short and long term is inelastic. In line with Putri (2010) research entitled Response to Corn Supply in Klaten Regency, it shows that 79.1% of corn supply in Klaten Regency can be explained by the variable price of corn in the previous year, the amount of corn production in the previous year, the area harvested in the previous year, price soybeans in the previous year, and the price of urea fertilizer in the year of planting. The value of the short-term and long-term supply elasticity for corn prices in the previous year is positively inelastic.

Conceptual Framework

Supply is the amount of a good or service that producers are willing to offer in the market at various price levels. If the price of an item increases, producers tend to increase the quantity of the goods produced. The increase in the number of offers made by producers is related to the increase in consumer demand for these goods. In this case, it encourages producers to increase their production so that supply continues to increase. Corn prices are the main factor in increasing corn supply. Corn supply is also influenced by the area harvested and the price of urea fertilizer.
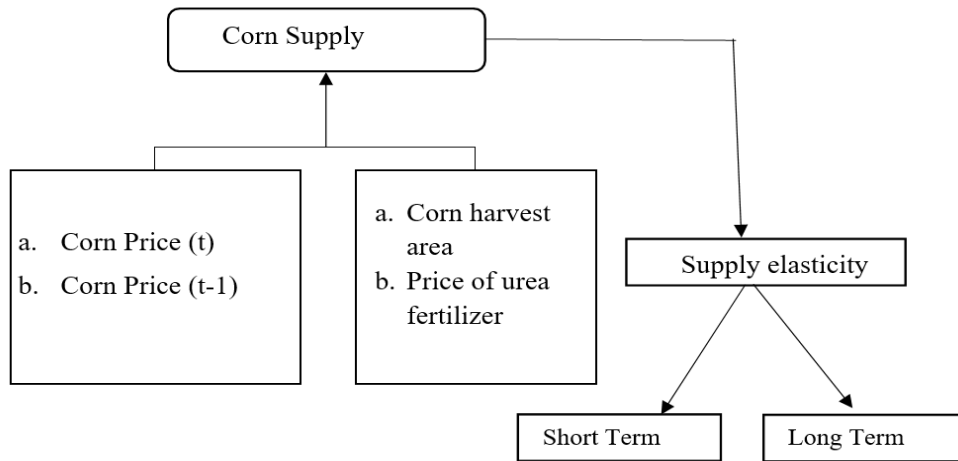
Figure 1: Conceptual Framework

Hypothesis
1. The price of corn in year t, the price of corn in year t-1, the area harvested and the price of urea fertilizer affect the supply of corn in North Sumatra Province.
2. The short-run elasticity of supply is inelastic and the long-run elasticity of supply is elastic in North Sumatra Province.

RESEARCH METHOD

The determination of the research area was carried out purposively, namely the method of taking the location intentionally for reasons of knowing the characteristics of the location. In this study, North Sumatra was chosen because maize production in North Sumatra continues to increase along with the increasing demand for maize. The data collected in this study is secondary data. Secondary data were obtained from the Central Statistics Agency (BPS) of North Sumatra Province and nationally, the North Sumatra Province Agriculture Service, and the North Sumatra Province Food Security Agency as well as other agencies related to the data used in this study. The data used is a time series, for 20 years, from 2000 to 2019.

RESULT AND DISCUSSION
Stationarity Test

This study tests the stationary data on the unit root test using the ADF (Augmented Dickey-Fuller Test) test. The procedure for determining whether the data is stationary or not is by comparing the statistical value of the ADF test (Augmented Dickey-Fuller Test) with the critical value of the MacKinnon statistical distribution, where the statistical value of the ADF test is indicated by the t statistic. If the absolute value of the ADF test statistic is greater than the critical value of the MacKinnon statistical distribution, then H0 is rejected, meaning that the observed time-series data is stationary. And conversely, if the absolute value of the ADF test statistic is less than the critical value of the MacKinnon statistical distribution, then H0 is accepted, which means the time series data is not stationary.

Table 2: Unit Root Test Results at Level

No	Dickey-Fuller test	t-Statistic	Prob.	Result
1.	Sjt (Corn Supply)	-0.040631	0.9431	Nonstationary
2.	Pjt (Corn Price)	-0.633145	0.8396	Nonstationary
3.	Pjt-1 (Corn Price t-1)	-0.528530	0.8638	Nonstationary
4.	Lpj (Harvest Area)	-0.478212	0.8755	Nonstationary
5.	Hpu (Price of Urea Fertilizer)	-0.565298	0.8567	Nonstationary

Source: Processed Eviews

In the unit root test stationarity test at the level, which shows the probability ADF value on all variables is greater than = 0.05, this indicates that the variables Sjt, Pjt, Pjt-1, Lpj, and Hpu are not stationary at the level. This means that these variables have the possibility of being integrated (having a long-term relationship). To determine the

degree of integration of the data, it is necessary to carry out further testing with a second test (test of the degree of integration): 1st Different-Trent & Intercept.

Integration Series Test

In the event that the results of the ADF test show that the observed time-series data is not stationary in the form of levels, it is necessary to transform it through a differencing process so that the data becomes stationary. Data in the form of difference is data that has been derived from the previous period, where the form of the first degree (first difference) can be denoted by I(1) then the ADF test procedure is carried out again if the observed time-series data is still not stationary at the first degree so that the differencing is carried out again second difference to obtain stationary data.

The results of the above processing can be seen in the unit root test stationarity test at the first difference level, which shows the probability ADF value on all variables is less than=0.05, this indicates that the variables Sjt, Pjt, Pjt-1, Lpj, and Hpu are stationary at first-difference level.

Table 3: Unit Root Test Results at First Difference level

No	Dickey-Fuller test	t-Statistic	Prob.	Result
1.	Sjt (Corn Supply)	-3.672240	0.0145	Stasioner
2.	Pjt (Corn Price)	-3.431096	0.0244	Stasioner
3.	Pjt-1 (Corn Price t-1)	-4.592920	0.0025	Stasioner
4.	Lpj (Harvest Area)	-3.829653	0.0106	Stasioner
5.	Hpu (Price of Urea Fertilizer)	-4.756246	0.0016	Stasioner

Source: Processed Eviews

Test Lag Length

The next step is to determine the optimal lag length. In the Distributed lag model, determining the length of the lag is important because a lag that is too long will reduce the number of degrees of freedom, while being too short will lead to specification errors. In determining the lag candidate, the selected lag length is using the Likelihood Ratio (LR), Final Prediction Error (FPE) criteria, Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Criterion (HQ). The indicator used in this research is Akaike Information Criterion (AIC).

Table 4: Optimal lag test results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-14.1604	NA	0.288821	1.595832	1.645539	1.604245
1	22.4722	65.5532*	0.006792*	-2.15497*	-2.05556*	-2.13815*

Source: Processed Eviews

The principle of the indicator is to give a penalty for adding a regressor to an equation that is included in an equation that contains lag. The lowest value of the AIC indicator is the best model. Thus, in determining the length of the lag selected is the smallest AIC criterion. From the results of data processing in Table 4, it can be seen that in testing the lag length on corn prices (Pjt) the AIC value at lag 1 is the lowest value, then the lag used in this study is lag 1.

Cointegration Test

Cointegration test was conducted to determine the existence of a relationship between variables, especially in the long term. If there is cointegration in the variables used in the model, it can be ascertained that there is a long-term relationship between the variables. The method that can be used to test the existence of this cointegration is the Johansen Cointegration method.

Table 5: Cointegration Test Results

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None *	0.800181	57.97890	47.85613	0.0042
At most 1	0.703869	28.99270	29.79707	0.0617
At most 2	0.317730	7.087527	15.49471	0.5675
At most 3	0.011356	0.205579	3.841466	0.6503

Source: Processed Eviews

From the output above, it can be seen that the statistical trace value is more than the critical value, namely 57.97890 > 47.85613, then the alternative hypothesis stating the number of cointegrations is accepted so that it can be seen how many equations are cointegrated in the system and in the long run there is cointegration in the equation model.

Estimating Distributed Lag Model with OLS

This study uses a distributed lag model analysis, because in this study the dependent variable is influenced by the independent variable at time t, and is also influenced by the independent variable at time t-1, and so on.

Table 6: Estimating Distributed Lag Model with OLS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.034763	2.208691	1.826766	0.0877
Pjt(Corn Price)	0.050244	0.263000	0.191042	0.8511
Pjt-1 (Corn Price t-1)	0.656341	0.236989	2.769500	0.0143
Lpj(Harvest Area)	0.542799	0.192665	2.817318	0.0130
Hpu(Price of Urea Fertilizer)	-0.270403	0.239401	-1.129495	0.2764
Prob(F-statistic)	0.000000			

Source: Processed Eviews

Interpretation of F-statistic Probability Value

The value of the Prob F-statistic is smaller than the significance of 0.05, which is 0.000. This can be interpreted that together/simultaneously the independent variables in the model, namely corn price (Pjt), previous corn price (Pjt-1), corn harvested area (Lpj), and urea fertilizer price (Hpu) have a significant effect on dependent variable corn supply in North Sumatra Province (Sjt) with a significant = 5%

Interpretation of Partial Probability Value

According to Pray it no (2014) the t-test is used to determine whether each independent variable independently significantly influences the dependent variable where if sig>0.05 then H0 is accepted and H1 is rejected and vice versa if sig < 0.05 then H0 is rejected. and H1 is accepted.

Effect of Corn Prices (Pjt) on Corn Supply (Sjt)

Based on the data described in Table 6, the significant value of corn price is 0.8511, which is greater than of 0.05 (5%). The price of corn in year t does not affect the supply of corn because to explain the slow response to changes in prices and other variables, there is a time lag between the decision to produce and the actual production that occurs. So the current production (Qt) due to the time lag will be influenced by past prices (Pt-1). This is the same as the research conducted by Rinda (2020) with the title "Analysis of Demand and Supply of Corn Commodities in Tulungagung Regency". According to Rinda, when the price of corn in year t rises, it will not affect producers to increase the supply of corn. Because when the price in year t is determined, the farmers have also finished harvesting, and the production guidelines in year t are based on the price of corn in the previous year.

The Effect of Corn Prices in the previous year (Pjt-1) on Corn Supply (Sjt)

Based on the data described in Table 6, the significant value of the previous year's corn price was 0.0143, which is smaller than of 0.05 (5%). This shows that the price of corn in the previous year had a significant effect on the supply of corn. Based on the coefficient value of the previous year's corn price has a positive relationship with the supply of corn that is equal to 0.656341 then every increase in the price of corn by 1,000 rupiah will increase the supply by 65.6 tons. These results indicate that the price variable in the previous year has an effect on corn supply in North Sumatra Province. If the

price of corn in the previous year was high, the amount of corn that would be offered would also increase along with the increase in the price of corn. High prices will encourage producers to increase their production and supply.

Based on the results of this study, the Cobweb theory and the law of supply apply where high prices will encourage corn farmers in North Sumatra Province to increase the quantity and quality of corn produced with the hope that high quantity can provide high profits while increasing quality will further increase demand for corn. The quality is seen from the shape of the seeds and the moisture content of the corn. The damaged form of corn and the higher water content in corn will result in lower corn prices. According to Widy, the previous year's corn price had an effect on corn supply in Grobogan Regency. Farmers in Grobogan Regency are more motivated to improve the quality and quantity of corn when corn prices are high. This also encourages corn farmers because there is a guarantee of a corn market with high prices for farmers.

Effect of Corn Harvested Area (Lpj) on Corn Supply (Sjt)

Based on the data described in Table 6, the significant value of the corn harvested area is 0.0130, which is smaller than of 0.05 (5%). Thus H0 is rejected, H1 is accepted. This shows that the corn harvested area has a significant effect on corn supply. This means that the larger the corn harvest area, the production will increase and the supply will be greater. Based on the coefficient value of the corn harvested area has a positive relationship with the supply of corn, which is 0.542799, so each additional 1 ha of harvested area will increase the supply by 54.2 tons. In line with the opinion (Chairia, 2015) the area of the harvested area is a factor that can affect the level of supply or the level of production of an item. If the area of a harvested area cannot meet the production of an item, then the goods produced cannot meet the number of

requests demanded by the community. So harvested area is one of the main factors in meeting the production of an item to increase supply. The increased maize harvested area will increase the supply of maize. This is supported by research conducted by Hapsari (2011) with the title "Analysis of Corn Supply in Grobogan Regency". According to Hapsari, when there is an increase in the corn harvested area variable, it will increase corn production which has an impact on increasing corn supply.

The Influence of Urea Fertilizer (Hpu) Prices on Corn Supply (Sjt)

Based on the data described in Table 6, the significant value of urea fertilizer price is 0.2764 which is greater than of 0.05 (5%). This shows that the price of urea fertilizer has no significant effect on the supply of corn. Based on the coefficient value of the price of urea fertilizer has a negative relationship with the supply of corn that is equal to -0.270403 then every increase in the price of urea fertilizer is however, in fact the use of fertilizer for corn cultivation by farmers is not too influenced by the increase or decrease in the price of urea fertilizer. Farmers then do not increase the use of fertilizers when prices are low or reduce them when prices increase so that it affects the quantity supplied. As long as urea fertilizer is available in the market, farmers will continue to use urea fertilizer for its production. So that the price of fertilizer in the year of planting does not affect the supply of corn in North Sumatra Province. This is supported by research conducted by Hapsari (2011) with the title "Analysis of Corn Supply in Grobogan Regency". According to Hapsari, the price of urea fertilizer does not affect the supply of corn in Grobogan Regency. Urea fertilizer is widely used by corn farmers in Grobogan Regency to increase their yields, so they tend to look for urea fertilizer for their farming according to the prevailing price. However, fluctuations in prices do not affect farmers in using urea fertilizer

because its use is adjusted to the needs of the plant.

North Sumatra Province Corn Supply Elasticity
Short-run elasticity of supply
In the short-term elasticity of supply < 1, namely 0.050244 < 1, it is inelastic which means that the percentage change in supply is smaller than the percentage change in price in the short term. Which means that every 1% change in the price of corn will increase the supply of corn by 0.05%.

Long-term supply elasticity
In the long-run elasticity of supply < 1, namely 0.706585 <1, it is inelastic which means that the percentage change in supply is smaller than the percentage change in price in the long run. Which means that every 1% change in the price of corn will increase the supply of corn by 0.71%.

Price predictions made by farmers at the time of cultivation are often different from prices when the harvest season arrives. If the price during the high harvest season cannot be immediately followed by a change in the supply of corn if the harvest season has not arrived, so farmers cannot adjust their production factors to increase supply.

When prices increase, farmers cannot increase the supply of corn if it is not yet harvest season, so the supply of corn cannot meet consumer demand for corn. When the supply cannot be increased because the farmers are not yet in the harvest season, there will be imports of corn to increase the supply of corn in North Sumatra Province. Based on Appendix 1. Imports of maize in North Sumatra have a high rate every year. In 2019, North Sumatra Province imported 76,670 tons of corn. And the highest imports occurred in 2011 amounted to 305.818.81 tons. This means that corn farmers in North Sumatra Province have not been able to meet the supply of corn to meet the demand for corn in North Sumatra Province.

CONCLUSION
The price of corn in the previous year (Pjt-1) with a probability value of 0.0143 and the area of harvest (Lpj) with a probability value of 0.0130 had a significant effect on corn supply in North Sumatra Province (Sjt), while the price of corn in year t (Pjt) with a probability value 0.8511 and the price of urea fertilizer (Hpu) with a probability value of 0.2764 has no significant effect on the supply of corn in North Sumatra Province.

The short-term elasticity is 0.050244 < 1, which means that every 1% change in the price of corn will increase the supply of corn by 0.05%. and long-term 0.706585 <1, which means that every 1% change in corn price will increase corn supply by 0.71%. is inelastic to the supply of maize in North Sumatra Province.

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