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Analysis of Corn Supply in Indonesia

Yulius Nugroho Ariyanto[1], Mubarokah[2], Hamidah Hendrarini[3]

[1,2,3] Master of Agribusiness, Faculty of Agriculture, UPN "Veteran" Jawa Timur, Surabaya, Indonesia

ABSTRACT: Corn is an important food commodity in Indonesia. Corn production in Indonesia is influenced by various factors, including price, land area, soybean price, subsidized NPK fertilizer price, post-harvest agricultural machinery assistance, and imports. This study aims to analyze the level of elasticity of corn commodities on the supply side. The results of the analysis show that corn supply in Indonesia is inelastic to the price, land area, and price of soybeans. However, corn supply is elastic to subsidized NPK fertilizer prices, post-harvest agricultural machinery assistance, and imports. The supply elasticity to the price of corn is 0.408, which means that if the price of corn increases by 1%, then the supply of corn will increase by 0.408%. The supply elasticity to land area is 1.578, which means that if land area increases by 1%, then corn supply will increase by 1.578%. The supply elasticity to soybean prices is -0.309, which means that if soybean prices increase by 1%, then corn supply will decrease by 0.309%. The supply elasticity to the price of subsidized NPK fertilizer is -0.016, which means that if the price of subsidized NPK fertilizer increases by 1%, then the supply of corn will decrease by 0.016%. The supply elasticity of post-harvest agricultural machinery assistance is 0.048, which means that if post-harvest agricultural machine tool assistance increases by 1%, then corn supply will increase by 0.048%. The elasticity of supply to imports is 0.232, which means that if corn imports increase by 1%, then corn supply will increase by 0.232%.

KEYWORDS: Corn supply; Factors affecting corn supply; Price of corn; Harvest area; Agricultural machinery assistance

I. INTRODUCTION

Food crop commodities have a very important role because they are basic needs for the community. The main sectors of food crop commodities include rice, maize, and soybeans, where the state is responsible for ensuring the availability of enough staple foods to meet these needs. Therefore, the government strives to increase food production in Indonesia in order to achieve food independence. However, various efforts to increase food production have not been accompanied by alignment of business chains from upstream to downstream, so there is often a mismatch between the number of offers that cause excess or lack of supply. Therefore, it is also important to ensure that food production and distribution businesses remain profitable for market participants, as an incentive for them to continue to grow their business. Corn (Zea mays, L.) is a food commodity of high value and has an important role in every part of the crop. In addition to being used as a food source, maize also has various uses as animal feed and in related industries, creating a long and sustainable linkage between maize and the livestock sector. Most corn production in Indonesia is used as animal feed, reaching around 60% to 70% of total production (Pusdatin Kemenan, 2021). The growing demand for animal feed makes maize one of the main commodities after rice, and the government is giving priority to increasing maize production as part of efforts to maintain food security. This step is implemented through various policies that affect the market climate and corn trade in the country.

Indonesia has great potential to meet market demand and produce various corn products, both for domestic consumption and export. According to the annual report of the Directorate General of Food Crops of the Ministry of Agriculture, in 2021, the area of land planted with corn in Indonesia reached 4,297,259 hectares, with a production of around 23,042,765 tons of dry corn (Laptah Kementan, 2021). East Java and Central Java are corn production centers with contributions of 25% and 13% respectively, producing a total of around 9 million tons per year, followed by the provinces of Lampung, South Sulawesi, and West Nusa Tenggara which are ranked third to fifth as corn production centers in Indonesia. This production potential can still be increased further, but it needs to be accompanied by appropriate market demand and supported by policies that accommodate business developments in the supply chain involving corn production to the animal feed industry.

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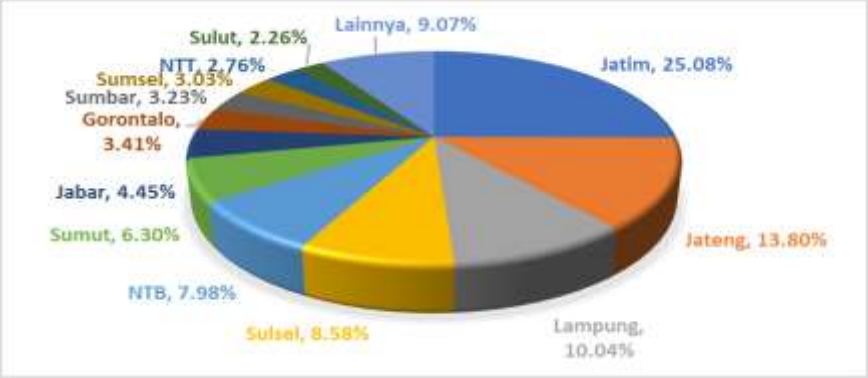

Figure 1.1 Corn Production Center Province in Indonesia, Year 2021

The maize sector in Indonesia is highly fragmented, with smallholders accounting for the majority of production. These farmers face several challenges in terms of access to technology, inputs, finance, and markets, which limit their productivity and competitiveness. In addition, Indonesia's maize sector is highly regulated, with government policies and subsidies playing an important role in shaping supply and demand dynamics. For example, restrictions on corn imports as raw materials for animal feed that affect the price offered and demand from feed producers and the substitution of other raw materials such as wheat, cassava and others, so that the price elasticity of corn becomes attractive and it is important to be studied so that the availability and magnitude of demand can be balanced and determined the maximum and minimum limits of production projections.

Indonesia ranks 8th as the world's corn producer, with a volume of 2,538 tons with a value of $4,235,326 (UN Comtrade, 2021). This volume is far below the import volume of 995,999 tons. Since 2017 Indonesia has not imported corn for feed, but only imports for food and beverages, the import of feed corn itself is regulated in Permendag No. 21 of 2021, but for exports there are no rules. With various potentials and abundance of corn, production and product value increase should be increased by conducting further analysis through observation of market trends and factors that influence efforts to increase and develop both to meet domestic demand and increase the country's foreign exchange through exports.

Currently, the government of the Republic of Indonesia encourages to increase national corn production through extensification policies to anticipate the possibility of a world food crisis as a logistics reserve and at the same time take advantage of the momentum of increasing market demand at home and abroad even though there are still many problems surrounding this commodity, ranging from data validity, trade distribution channels, efforts to increase production, to the carrying capacity of corn production to the industry. BPS Deputy for Production Statistics, M. Habibullah said that the problem of corn data lies in the difference in productivity calculations, especially the moisture content of corn. The data presented today is likely not the same as that recommended by the USDA, and FAO. The government continues to find solutions to increase corn production to meet domestic corn needs, as well as to meet export market demand.

The Indonesian government has implemented several policies aimed at increasing the competitiveness of the country's maize sector and increasing maize production. Some of these policies include:

1. Provision of seed assistance: The government provides corn seed subsidies to farmers, aiming to improve the quality of domestically produced corn as stated in the corn strategic plan 2019-2024;
2. 2.Promoting new technologies: The government promotes the use of modern technologies such as precision agriculture and genetic improvement to increase maize yields as stated in the maize strategic plan 2019-2024;
3. 3.Developing market access for small-scale farmers: The government strives to increase market access for small-scale corn farmers, including by supporting the development of small and medium enterprises in the corn sector to strengthen competitiveness by limiting corn imports through Regulation of the Minister of Trade (Permendag) Number 21 of 2018 and Regulation of the Minister of Agriculture (Permentan) Number 57 of 2015 concerning ministerial recommendation letters for corn imports and corn import rights;
4. 4.Encouraging private sector investment: The government encourages private sector investment in the corn sector, including through tax incentives and other fiscal policies such as determining the basic price of corn purchases as stipulated in Permendag No. 27 of 2017;
5. 5.Increase financial access: The government is working to improve financial access for maize farmers, including through microfinance programs and the development of rural financial institutions through collaborative activities of the Ministry of Cooperatives and MSMEs as well as the Ministry of Rural Affairs.

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Based on the strategic plan of the Ministry of Agriculture 2020-2024, in 2017 corn production reached 28.92 million tons of dry shells, an increase of 47.48% compared to production in 2015, which only amounted to 19.61 million tons of dry shells. The significant increase in production is the result of the Special Efforts program through the development of 3 million hectares of maize, the integration of oil palm/plantations and forestry with corn, partnerships with the Association of Animal Feed Companies (GPMT) with corn farmers and the lower price policy at the farmer level. It is estimated that more than 60% of domestic corn needs are used for feed, while for food consumption only about 24%, the rest is for other industrial needs and seeds (14%).

The development of corn production in the 2015-2020 period shows growth every year, except in 2018. However, after 2018, during the 2019-2020 period, corn production continued to increase. The improving trend of world corn prices in January-June 2022, which increased by 21.53% compared to the same period in 2021, is an opportunity for Indonesia to export corn. Through intensification in the form of increasing productivity and extensification in the form of expanding new planting areas, the Government hopes to increase corn production, both to meet domestic availability and meet demand from other countries. Currently, several corn exporting countries implement export restrictions to prioritize meeting their domestic needs. This policy resulted in an increase in world corn prices, as well as the impact of current global geopolitical conditions due to the Russia-Ukraine conflict. The average price of corn has increased, with the average price update in June 2022 reaching USD 335.71/Ton. International corn prices reached the highest price in April 2022 of USD 348.17/Ton and tended to decline slightly until June 2022 (databoks.com, 2021). With global prices now at USD335 per ton or equivalent to Rp5,000 per kg, the President gave directions to increase production, including extensification of existing land. Although this figure still needs to be studied how it impacts the offer (Menko).

Based on the strategic plan of the Ministry of Agriculture 2020-2024, in 2017 corn production reached 28.92 million tons of dry shells, an increase of 47.48% compared to production in 2015, which only amounted to 19.61 million tons of dry shells. The significant increase in production is the result of the Special Efforts (UPSUS) program through the development of 3 million hectares of maize, integration of oil palm/plantations and forestry with corn, partnerships with the Association of Animal Feed Companies (GPMT) with corn farmers and lower price policies at the farmer level. It is estimated that more than 60% of domestic corn needs are used for feed, while for food consumption only about 24%, the rest is for other industrial needs and seeds (14%). The development of corn production in the 2015-2020 period shows growth every year, except in 2018. However, after 2018, during the 2019-2020 period, corn production continued to increase (Airlangga, Coordinating Minister for the Economy, 2022). To increase national corn production, the Ministry has determined 6 (six) locations for increasing national corn production, namely in the provinces: (1) Papua; (2) West Papua; (3) NTT; (4) Moluccas; (5) North Maluku; (6) North Kalimantan, with a total land area of 141,000 Ha, of which 86,000 Ha is a new planting area.

The estimated production of corn with a moisture content (KA) of 27.81% (Wet Pipilan Corn in Farmers), by the end of the year can reach 25.3 million tons. Meanwhile, the estimated corn production with 14% KA (Corn Store in Warehouses) reached 18.7 million tons. While the need for industry, especially the animal feed industry is around 15 million tons, so there are still national corn reserves of around 3 million tons, which are prioritized for national needs reserves. The pattern of increasing corn demand is based on the use of corn, namely (1) direct consumption, (2) feed industry, (3) independent farmers, (4) seeds, and (5) food and non-feed industries. In general, the five types of corn use are projected to continue to increase, but at different rates. The need for corn for feed raw materials, both for the feed industry and for independent farmers, is projected to experience the highest growth rate of around 3.6% per year. In 2016, the need for the feed industry plus the need for corn for independent farmers reached 70% of the total use. Government policy to continue to encourage self-sufficiency in corn commodities is interesting to study, because currently the position of corn in several years since 2009 has experienced a surplus, while export figures have not increased significantly. The absorption of domestic corn production has also not increased too significantly. Corn imports are distinguished according to form, namely fresh and processed forms. In 2020, Indonesia's corn exports were dominated by processed forms while imports were dominated by fresh forms. Processed corn exports in 2020 reached 54.29% of the total value of Indonesian corn exports. Meanwhile, fresh form corn was imported by Indonesia amounting to 56.49% of the total value of corn imports in 2020. Although the government has tried to limit the amount of imports, the allocation of products for export is still very limited because domestic demand is still prioritized, but seeing the increasing production trend, it needs to be considered so that the government and market players begin to explore and open export opportunities so that domestic prices can be balanced so that market balance can be created and surpluses from production can be answered. Through this study, the author tries to answer what are the most influential factors to be able to create balance by looking at the price elasticity of the most influencing factors.

II. LITERATURE REVIEW

Corn Commodities

Corn plants have several growing conditions that will support productivity and yields including loose soil and rich in humus making corn plants grow optimally, and with a degree of similarity (pH) soil between 5.5 - 7.5, with a depth of groundwater 50 - 200 cm from the soil surface and an effective depth of soil reaching 20 - 60 cm from the soil surface. Corn plants can grow in various types of soil ranging from dusty loam to clay, but corn prefers dusty clay soil types (M. Fiqriansyah et al, 2021). High-yielding varieties are another component in the corn production system. In general, there are fundamental differences in morphology between deep-lived and genjah-aged varieties, including plant height, leaf length and width. In general, genjah-aged plants have a better response to high population densities. High-yielding varieties of maize that have been released in Indonesia are generally recommended to be planted in lowlands, below 800 m above sea level. Some 10 hybrid corn varieties can adapt well in medium to high altitudes High-yielding varieties have better growth, sturdy roots, erect stems, fall tolerance, fast growing, harvest age of 95 days, optimum population of 66,887 plants/hectare, and rust disease resistance (M. Fiqriansyah et al, 2021).

Trend Theory

Trend is the general direction or tendency of certain changes in behavior or demand patterns seen over a relatively long period of time (Kotler, 2016) On average, these changes can increase can decrease. If the average change increases it is called a positive trend or the trend has an uptrend. Conversely, if the average change decreases it is called a negative trend or a trend that has a downtrend. Trend lines are basically regression lines and the independent variable (x) is a time variable. A straight line trend (linear) is a trend that is predicted to rise or fall in a straight line. Time variables as independent variables can use yearly, semesterly, monthly, or weekly time. Straight-line trend analysis consists of the least square and moment methods. Trends show changes in the value of a relatively stable variable, population changes, price changes, technological changes, and productivity increases. Trend analysis in this study uses a method obtained by determining the equation of the line that has the smallest sum of squares of the difference between the original data and the data on the trend line. This least squares method is the most widely used in scaled series analysis for business forecasting.

The calculation formula:

$$Y = a + bx$$
$$b = n\sum XY - \sum XY \; n\sum X2 - (\sum X)^2$$
$$a = \sum Y \; n - b \sum X \; n$$

Information:

Y = is the value of the forecast with the trend.

a = a fixed value (constant) or the value of Y' on X is equal to zero.

b = slope or change in Y value over time.

x = period of time over time.

Supply Theory

An offer is a quantity of goods that are willing to be sold at various price levels and at a certain period of time. If the price of an item is so low that it cannot cover production costs, there will be no number of goods to sell. At a higher price there will be a number of items that you want to sell. So the offer can be expressed the higher the price of an item, the more the number of goods to be sold, conversely the lower the price of an item, the less the number of goods to be sold (Zahara, 2021). The Law of Supply reads "If the price of a good / service increases then the amount of goods offered will increase and vice versa if the price falls then the amount of goods offered will decrease assuming ceteris paribus" The law means that if the price of a good increases then the quantity of goods offered will increase (because producers are more profitable), and vice versa if the price falls, The amount of goods offered also decreases (since it is less profitable for producers). As in demand analysis, a supply curve can also be created that shows various possible prices with the number of goods offered. As in the following it is shown that the increasing price of an item, the more the number of goods offered increases and vice versa, assuming ceteris paribus (Sardjono, 2017). It is difficult to express precisely what factors can affect the demand for goods and services because the factors that affect the demand for a good / service are also determined by the type of goods, situation, conditions, and time. In general factors affecting bidding (Zahara, 2021):

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$$Qs = (PX, PY, Pi, t, c, Tp, Jp, Keb)$$

Information:
PX = Price of the item itself
PY = Price of other goods
Pi = Input price
t = Technology owned
c = Cost of production
Tp = Company goals
Jp = Number of traders
Keb = Government policy

Price Theory

Price is the value of money that must be paid by consumers to sellers for the goods or services they buy and in other words, price is the value of an item determined by sellers. Prices are formed when an equilibrium level between offers is reached. It can be said that the equilibrium price or market price or *equilibrium price is the* price that occurs when the quantity of goods demanded is equal to the number of goods offered. There is an agreement between the price requested by the buyer and the price offered by the seller for an item being transacted. The meeting point of these two prices is then agreed upon as the market equilibrium price (Goenadhi &; Nobaiti, 2017).

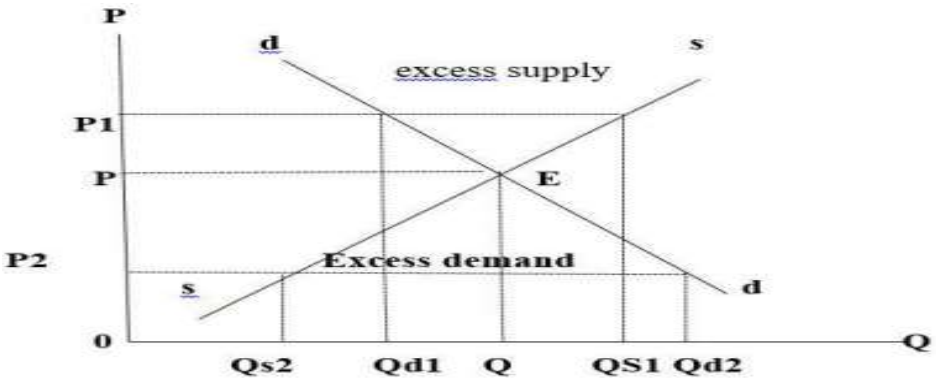

Figure 2 Equilibrium Price

Information:
dd = demand curve
ss = supply curve
E = equilibrium point (dd=SS) where the equilibrium price occurs

Elasticity

Elasticity indicates sensitivity. Price elasticity on demand or price elasticity is the sensitivity of the quantity of a good demanded to changes in the price of that good, assuming that everything else does not change (Samuelson, et. Al 1999) Elasticity is a sense that requires the degree of sensitivity. Elasticity of demand increases the degree of sensitivity of the function. Request for changes that occur in variables that replace them. The magnitude of elasticity coefficiency is shown by the comparison between the percentage change in the non-free variable and the percentage change in the independent variable that affects it (Suparmoko, 1999). This quantitative measure is called demand elasticity. Demand elasticity is divided into three concepts: price demand elasticity, income demand elasticity, and cross demand elasticity (Sukirno, 2016).

1. Price Elasticity of Demand is the effect of changes in prices on the size of the amount of demand for goods or the level of sensitivity of changes in the amount of demand for goods to changes in the price of goods. While the size of the change in demand is expressed in the coefficient of elasticity or elasticity number abbreviated as Ed.
2. Cross Price Elasticity is a coefficient that shows the extent to which the magnitude of the change in demand for a good if there is a change in the price of another good, where the percentage change in the amount of demand for goods x, which is caused by the percentage change in the price of other goods (y).
3. Income Elasticity is a coefficient that shows the extent to which the magnitude of the change in demand for a good as a result of changes in buyer income.

III. RESEARCH METHODOLOGY

Research Type and Design

The type of research to be carried out is quantitative descriptive analysis research with purposive sampling based on corn market conditions at the national level which have a wider scope than the regional level, besides that conditions that have reached a surplus but market absorption options are still limited to food and feed products which on the policy side still continue to encourage increased production so that the balance of supply becomes attractive for further investigation. Before the analysis is carried out to obtain fiscal data, secondary data analysis will be carried out to understand the general constraint conditions in corn commodities using data derived from various references to previous research including government statistical data. Based on the results of secondary data analysis on the supply side, the next step is to make supply projections based on government policy achievement targets which then the results will be tested on various variables that affect elasticity, price and production effectiveness at the farmer level and feed processing industry using correlational analysis to see the variables most influenced by government policies in general. Correlational analysis was chosen because it is to obtain market balance on the supply side to be able to see various variable factors that can be tested for the strength of the relationship between policies and the most influenced factors to be able to achieve balance and readiness to compete in the export market. To complete and deepen the understanding of the dynamics of the corn market, this study will also analyze the elasticity of corn prices in Indonesia is in a surplus production position as it is happening today.

Data Collection Methods

The data collection method used in the study is using data from various sources. Secondary data is data obtained from a published source such as a government publication or the publication of an organization / association.

The data is obtained from annual documents related to or related to the discussion. The data used is time series data for 20 years, namely data from 2002 to 2021. Secondary data sources are obtained from:

1. Central Bureau of Statistics (BPS)
2. Local Corn Uptake Data from the Office of the Directorate General of PKH of the Ministry of Agriculture
3. Data and Information Center of the Ministry of Agriculture
4. United States Department Agriculture
5. UN Comtrade (International Trade Statistics Database)
6. Databoks.com

DATA ANALYSIS METHODS

In accordance with the purpose of the study, the analysis used is quantitative descriptive analysis. Quantitative methods are used to analyze corn supply trends. Which then analyzes the factors that most significantly affect the supply of Indonesian corn then market balance and the level of elasticity in the supply function. The analytical tools used in quantitative methods are trend and gap analysis then multiple linear regression analysis with Time series data and Cobb-Douglas multiple linear method to calculate elasticity. The determination of econometric models also goes through the stage of determining the model. The results of data processing are then tested for accuracy through classical assumption tests and statistical tests. Processing of research data using Microsoft Excel for 365 and Eviews 9 software.

Elasticity Measurement

Testing the fourth hypothesis about the elasticity of corn demand in Indonesia can also be known from the regression coefficient (β) results of the multiple regression analysis of the CobbDouglas model. The last hypothesis testing aims to analyze the level of sensitivity (elasticity) of Indonesian corn supply calculated using the following formula:

$$\eta = \frac{\partial Q/Q}{\partial X/X} = \frac{\partial Q}{\partial X}\cdot\frac{X}{Q} = \frac{\partial Q}{\partial x}\cdot\frac{1}{Q} = \frac{\partial Q}{\partial x}\cdot\frac{x}{Q}$$

The elasticity of supply can be determined from Cobb-Douglas multiple regression with the following supply function:

$$Q_X = \beta_0 X_1^{\beta_1} X_2^{\beta_2}$$

e.g. X1 and X2 factors are used. The marginal product of X1 is as follows:

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$$MP_{X_2} = \frac{\partial Q}{\partial X_2} = \beta_2 . \beta_0 X_1^{\beta_1} X_2^{\beta_2 - 1}$$
$$= \beta_s \frac{\beta 0 X 1 \beta 1 X 2 \beta 2}{X 2}$$
$$= \beta_s \frac{Q}{X 2}$$

Since Q/X is the average production or AP, while the marginal product is $\partial Q / X$, if a particular factor is denoted as X, then the elasticity X can be simplified to:

$$\eta x = MP \frac{1}{AP}$$
$$\eta x = \frac{1MP}{AP}$$

Thus, the elasticity of the X1 factor can be expressed as follows:

$$elastisitas\ X_1 = \frac{MPx1}{APx1} = MPx1 \cdot \frac{1}{APx1}$$
$$= \beta 1 \frac{Q}{X1} \cdot \frac{1}{\frac{Q}{X_1}} = \beta 1 \frac{Q}{X1} \cdot \frac{X1}{Q}$$
$$= \beta 1$$

while the elasticity of the factor X2 can be expressed as:

$$elastisitas\ X_2 = \frac{MPx2}{APx2} = MPx2 \cdot \frac{1}{APx2}$$
$$= \beta 2 \frac{Q}{X2} \cdot \frac{1}{\frac{Q}{X_2}} = \beta 2 \frac{Q}{X2} \cdot \frac{X2}{Q}$$
$$= \beta 2$$

It was thus proved that the regression coefficients (β 1 and β2) of the Cobb-Douglas production function are also input elasticity. Decision making criteria:

1. Supply is elastic (η > 1), meaning that if there is a change in factors that affect supply, it will increase the change in supply beyond the percentage change in those factors.
2. Unitary supply (η = 1), that is, the percentage change in factors that affect supply is equal to the percentage change in supply.
3. Supply is inelastic (η < 1), that is, if there is a change in factors that affect supply, it will increase the change in the time series of supply but not as much as the increase in changes in these factors.

IV. RESULT AND DISCUSSION

Elasticity of Corn Supply in Indonesia

Supply elasticity measures the extent to which the quantity supplied changes in response to changes in price and other variables. This is crucial in understanding how Indonesia's maize supply will respond to change. In this analysis, the variable factors that affect the supply function are converted into the cobb-douglas production function. The Cobb-Douglas production function is a model that describes how inputs are used to produce output in production. The equation obtained from the regression result of the supply function is:

Y= -14799212+2.009.98 X1+6.321X2 -736.636X3-120.473X4+691.779X5+2.477X6

For the calculation of elasticity using the following formula:

$$\eta = \beta \frac{Q}{X} \cdot \frac{X}{Q} = \frac{\Delta Q}{\Delta X} \cdot \frac{\bar{Y}}{\bar{Q}}$$

Obtained by calculating the average of each variable (X bar and Q bar) then calculating the level of elasticity in each variable and obtained the results in the table as follows:

Table 1. Calculation Results of Factors Influencing Elasticity of Corn Supply

Variable	Coefficient Estimation	Xbar (Average) Variable	Q (Y) Average Supply	Elasticity
(X1) Corn Price	2009.98	3185.78	15699151.22	0.408
(X2) Land Area	6.32	3919035.50	15699151.22	1.578
(X3) Soybean Price	-736.64	6587.81	15699151.22	-0.309
(X4) Price of Subsidized NPK Fertilizer	-120.47	2035.75	15699151.22	-0.016
(X5) Postharvest Alsin Assistance	591.80	1269.61	15699151.22	0.048
(X6) Import	2.48	1468705.85	15699151.22	0.232

Interpretation of elasticity calculations

The elasticity of supply to changes in the price of corn (X1), shows that if there is an increase in price by 1%, then the supply of corn will increase by 0.408%, which means that this variable is inelastic because less than 1 ($\eta < 1$), the relationship is positive that if there is a change in price it will increase the change in supply but not as much as the increase in price change assuming ceteris paribus. This happens because corn commodities are included in the group of basic needs where the price factor is regulated by the government through various interventions such as determining the base price and the highest retail price.

The elasticity of supply to land area change (X2), shows that if there is an increase in land area by 1%, then corn supply will increase by 1,578%, which means that the variable land area is elastic because it is more than 1 ($\eta > 1$), the relationship is positive which means that if there is a change in land area it will affect the supply, exceeding the percentage of land area change, Likewise, if there is a decrease in land area, the number of offers will also decrease beyond the decrease in land area assuming ceteris paribus. The area of corn production still has the potential to disrupt supply stability, because the area of land owned by farmers is getting smaller due to various things, but it can still be pursued through intensification to increase productivity and this has been a concern for a long time with various programs carried out.

The elasticity of supply to soybean price changes (X3), shows that if there is an increase in soybean prices by 1%, then corn supply will decrease by 0.309%, which means that the soybean price variable is inelastic because less than 1 ($\eta<1$) the relationship is negative, which means that soybeans are complementary crops that are simultaneously produced together with corn, if there is a change in soybean price increases it will affect the decrease in corn supply, But lower than the percentage change in soybean prices, as well as if there is a decrease in soybean prices, the amount of corn supply will increase but not exceed the soybean price reduction assuming ceteris paribus. Soybean prices do not interfere too much with supply stability, because fluctuating soybean prices due to various things, such as government policies and cheap imported soybeans, have not made soybeans a crop that competes directly because they are often planted only as a complement or tumpeng insert.

The elasticity of corn supply to subsidized NPK fertilizer prices (X4), shows that if there is an increase in subsidized NPK fertilizer prices by 1%, then corn supply will be reduced by 0.016%, which means that the variable price of subsidized NPK fertilizer is inelastic because less than 1 ($\eta<1$) of the relationship is negative, which means that subsidized NPK fertilizer is a complementary variable that not all corn farmers can get access to subsidies, if there is a change in the price increase of subsidized NPK fertilizer will affect the decrease in corn supply, but lower than the percentage change in the price of subsidized NPK fertilizer, as well as if there is a decrease in the price of subsidized NPK fertilizer, the amount of corn supply will increase but not exceed the decrease in soybean price assuming ceteris paribus. Subsidized NPK fertilizer is a form of government effort to reduce production costs to farmers, but often the uneven distribution of subsidized fertilizers sometimes makes farmers choose non-subsidized fertilizers to pursue the planting season.

The elasticity of supply to post-harvest agricultural machinery assistance (X5), shows that if there is an increase in alsintan assistance by 1%, then corn supply will increase by 0.048%, which means that the variable alsintan assistance is inelastic because it is less than 1 ($\eta < 1$), the relationship is positive, which means that if there is a change in the amount of post-harvest

alsintan assistance, it will affect the supply, But it does not exceed the percentage change in the amount of alsintan distributed, as well as if there is a decrease in the amount of alsintan assistance, the amount of offers will also decrease but not exceed the decrease in the amount of alsintan provided by the government assuming ceteris paribus. Assistance for agricultural machinery tools for post-production corn still has the potential to increase supply while introducing technology and quality of crops, because it is time for farmers to pursue increased productivity through the use of technology, in addition to reducing costs, post-harvest alsintan assistance The purpose of this assistance is to introduce technology to farmers in the hope that farmers can be more effective and efficient in producing corn.

The elasticity of supply to changes in imports (X6), shows that if there is an increase in corn imports by 1%, then the supply of corn will increase by 0.232%, which means that the import variable is inelastic because it is less than 1 ($\eta < 1$), the relationship is positive, which means that if there is a change in the amount of corn imports, it will affect supply, but not exceed the percentage change in corn imports, Likewise, if there is a decrease in corn imports, the number of offers will also decrease but not exceed the decrease in the number of corn imports assuming ceteris paribus. Corn imports, which are currently limited by the government only to food sources but not to feed, are government efforts to protect corn farmers from competitiveness and global prices, but at the right time the government will need to review the extent to which import restrictions are still needed when domestic corn production is able to compete in terms of quality and production cost efficiency.

By understanding how these factors affect supply, corn producers can make better decisions about how much corn to offer at various price points.

The results of the analysis show that corn supply in Indonesia is influenced by various interacting factors. Some factors have a negative impact, such as competition with other crops and limited human resources in the application of technology, and less relevant subsidy policies such as fertilizer subsidies, while other factors have a positive impact, such as technology support and infrastructure development. In the face of these challenges, the government and the private sector must work together to develop adequate strategies to increase maize supply. Possible strategies proposed include:

1. Increase production cost efficiency to maintain supply price stability and profits expected by producers (farmers).
2. optimize the use of existing land by increasing productivity through efficient agricultural technology.
3. Increase technology and infrastructure support, such as irrigation and transportation facilities, to improve the quality and facilitate the distribution of corn.
4. Overcoming resource limitations by adopting better resource management techniques, such as the use of organic fertilizers or water-efficient irrigation systems.

   By implementing this strategy, corn supply in Indonesia is expected to increase, thus meeting consumption needs and helping sustainable economic growth.

V. CONCLUSION AND SUGGESTION

Conclusion

From the analysis of the elasticity of corn supply in Indonesia, based on the equation generated through the Cobb-Douglas production function, the following important points can be concluded:

1. The elasticity of supply to the price of corn is inelastic because it is less than 1 ($\eta < 1$), the relationship is positive that if there is a price change of 1% it will increase the change in supply by 0.408% but not as much as the increase in price change assuming ceteris paribus. This happens because corn commodities are included in the group of basic needs where the price factor is regulated by the government through various interventions such as determining the base price and the highest retail price.
2. The elasticity of supply to changes in land area is elastic ($\eta > 1$), if there is an increase in land area by 1%, then the supply of corn will increase by 1,578%, the relationship is positive, which means that if there is a change in land area it will affect supply, exceeding the percentage change in land area, The area of corn production still has the potential to disrupt supply stability, but it can still be pursued through intensification to increase productivity.
3. The elasticity of supply to soybean price changes is inelastic ($\eta<1$), if there is an increase in soybean prices by 1%, then corn supply will be reduced by 0.309%, the relationship is negative, which means that soybeans are a complementary crop that is often produced together with corn, soybean prices do not interfere too much with supply stability, because soybean prices fluctuate due to cheap imported soybeans, has not made soybeans a crop that competes directly because it is often planted only as a complement or tumpeng insert.
4. The elasticity of corn supply to the price of subsidized NPK fertilizer is zero inelastic ($\eta<1$), if there is an increase in the price of subsidized NPK fertilizer by 1%, the relationship is negative, which means that subsidized NPK fertilizer is a complementary variable that not all corn farmers can get access to subsidies. Subsidized NPK fertilizer is a form of

government effort to reduce production costs to farmers, but often the uneven distribution of subsidized fertilizers makes farmers choose non-subsidized fertilizers to pursue the planting season.

5. The elasticity of supply to post-harvest agricultural machinery assistance is inelastic (η<1). If there is an increase in alsintan aid by 1%, the supply of corn will increase by 0.048%. This relationship is positive, which means changes in the amount of post-harvest alsintan relief will affect corn supply assuming other factors remain constant. The assistance of agricultural machinery tools for post-production corn has the potential to increase supply and introduce technology and improve crop quality. Today, farmers need to increase productivity through the use of technology, in addition to reducing production costs. The purpose of post-harvest alsintan assistance is to introduce technology to farmers in the hope that they can be more effective and efficient in corn production.
6. The elasticity of supply to changes in imports is inelastic (η < 1), if there is an increase in corn imports by 1%, then corn supply will increase by 0.232%, the relationship is positive, which means that if there is a change in the amount of corn imports, it will affect supply, but not exceed the percentage change in corn imports assuming ceteris paribus. Corn imports, which are currently limited by the government only to food sources but not for feed, are government efforts to protect corn farmers from competitiveness and global prices, but at the right time the government will need to review the extent to which import restrictions are still needed when domestic corn production is able to compete in terms of quality and production cost efficiency.

Suggestion

Based on these conclusions, here are some suggestions that can be given:

1. Improve the quality of domestic production. Because domestic production has a large contribution to corn supply, efforts to improve the quality of domestic corn production need to be increased. This can be done through increasing agricultural innovation and technology, as well as improving the quality of seeds and farmers' knowledge related to good and correct corn cultivation.
2. Support the adoption of post-harvest machinery technology. Increased use of post-harvest machine tool technology can increase corn supply. Therefore, the government and relevant stakeholders need to provide support in the form of training, access, and subsidies for this technology.
3. Evaluate Import Restriction Policy. Corn imports have a significant influence on corn supply. The government needs to evaluate corn import activities to stabilize domestic corn supply by taking into account the readiness of competitiveness and production cost efficiency.
4. Improvement of Production Support Facilities. Production support facilities such as quality seeds, land mekasnization and information media for corn farmers, can help in increasing corn supply.

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