MAIZE SUPPLY RESPONSE IN INDONESIA

Respon Penawaran Jagung di Indonesia

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Abstrak

Permintaan terhadap komoditas jagung di Indonesia terus meningkat karena produksi jagung tidak memadai untuk mencukupi konsumsi jagung yang terus meningkat. Dampak dari kondisi ini adalah terjadinya kelangkaan komoditas jagung dan meningkatnya harga jagung. Penelitian ini bertujuan untuk menganalisis respon penawaran petani jagung terhadap perubahan harga input dan output. Dalam penelitian ini, juga dilakukan upaya untuk menguji respon penawaran petani jagung di Indonesia dengan menggunakan metode Error Correction Model (ECM)*. Penelitian ini menggunakan data sekunder. Hasil penelitian menunjukkan bahwa penawaran petani terhadap jagung dipengaruhi oleh harga kedelai, upah tenaga kerja, harga benih, harga pupuk urea, harga pakan, dan harga jagung impor. Petani jagung juga responsif terhadap harga jagung, oleh karena itu, kebijakan stabilitas harga dan kebijakan harga dasar dapat diberlakukan kembali untuk mendukung swasembada jagung. Penelitian ini juga merekomendasikan bahwa masih perlu kebijakan subsidi input dan perluasan lahan untuk meningkatkan penawaran jagung.*

Kata kunci : *Respon Penawaran, Jagung, Perubahan Harga, ECM*

Abstract

Demand for maize in Indonesia keeps growing due to low maize production, while consumption keep increasing (excess demand). The situation creates scarcity in maize and leads to the commodity's high price. This study aims to analyze the supply response of maize farmers on the changes of input and output prices. This study also examines the supply response of maize farmers in Indonesia by using Error Correction Model (ECM). The study uses secondary data. Results of the study shows that supply of maize farmers is influenced by price of soybeans, wages of labor, prices of seed, of urea fertilizer, of feed, and of imported maize. Maize farmers are also responsive to changes in maize prices and therefore the policy of maize floor price can be re-applied to support the national food self-sufficiency. In addition the input subsidy and land expansion policies are still necessary to increase maize supply.

Keywords: Supply Response, Maize, Price Change, ECM

JEL Classification : Q22, Q11, Q13

INTRODUCTION

Maize's role as a source of second carbohydrates after rice as well as animal feed raw materials, has made it as a strategic commodity. It shows that maize has an important role in the supply of animal protein, and that its production capacity needs to be improved. Domestic market demand and export opportunities of maize is likely to increase from year to year, both to meet the food and non-food needs. In addition, the market prospects for maize production is getting better, because it is supported by better community's awareness of food nutrition and diversification. Maize is used as the main domestic industrial raw material for food processed products such as maize chips, maize wingko. as animal feed raw materials, and for exports. This further creates potential market opportunities for maize farmers and making it very important to increase the quality and quantity of maize production. The description of maize consumption in Indonesia can be seen in Table 1.

Table 1. Maize consumption in Indonesia

Demand	Year		Growth (%)
	2015	2016	
Seed (000 Tons)	84	86	2.38
Feed Industry Raw Material (000 Tons)	8.360	9.241	10.54
Raw Material of Independent Breeders (000 Tons)	4.059	4.302	5.99
Direct Consumption (000 Ton)	340	316	-7.06
Food Industry Raw Materials (000 Ton)	4.092	4.323	5.65
Scattered (000 Ton)	1.033	1.091	5.61

Source: Pusdatin (2016)

Table 1 shows that the largest demand for maize comes from the feed industry, which increases 10.54% annually for feedstock industry demand and increases by 5.99% for the demand of raw material for self-farmers. The direct consumption of maize decreased significantly in 2015 by 7.06%, but demand as raw materials for the food industry shows an increase. This implies that demand for maize will continue to increase as the demand of the feed industry in Indonesia is increasing.

Demand of maize experienced a rapid growth rate for 5 years, during 2012-2016, amounting to 6.16% per year. The demand growth exceeds the growth rate of population with only 2.01% per year in the same period (Kemendag, 2016). Demand for maize for feed, food industry and feed raw materials as well as the future for energy raw materials (bioethanol) will be increasing from year to year. During the period of 2012-2016, data shows that the national maize production is always below the total national maize demand. Therefore, to meet a variety of needs (for food or direct consumption, raw material processing industry and particularly of feed raw materials), imports of maize were made in that period ranging from a total of 1,805 - 3,500 thousand tons.

During the period of 5 years (2012-2016), the growth rate of supply/production of maize was slow (4.89% per year) and fluctuated, while demand grew 3.40% annually. This indicates that there is an increased need to be met by domestic maize production. Table 2 shows that the Indonesian maize consumption is higher than national maize production. The proportion of maize production from 2012 to 2016 increased and in 2016 the proportion reached 96.34% while corn imports decreased drastically by the proportion of 3.66% in 2016. This indicates that there is an increase in production to meet domestic demand due to an increase corn land area.

Table 2. Development of Production, Imports and Demand of Corn Indonesia in 2012-2016

Year	Production (000 Tons)	Growth (%)	Imports (000 Tons)	Growth (%)	Harvested Area (000 Ha)	Growth (%)	Demand (000 Tons)	Growth (%)
2012	19387		1805		3958		21093	
2013	18512	-4.51	3194	76.95	3822	-3.44	20893	-0.95
2014	19008	2.68	3175	-0.59	3837	0.39	22182	6.17
2015	19612	3.18	3500	10.24	3787	-1.30	23571	6.26
2016	23188	18.23	881	-74.83	4388	15.87	24069	2.11
Average	19941		2511		3958.4		22371	

Source: Pusdatin (2016)

This has implications for their excess demand to be met. Excess demand is met by maize from imports. When examined further, the import of maize from 2012 to 2016 has increased significantly. Imports of maize are needed by Indonesia to be a buffer in making maize available when the domestic maize production decreases. It aims to reduce domestic price volatility of maize (maize price stabilization), which is caused by the excess demand.

Maize import activity is still ongoing over time, despite the trend of national maize production showed an increase. Import is done in particular by the animal feed industry, with some reasons, among others: (1) security of supply and the ease of obtaining raw materials. Industry has difficulties in keeping track of existing excess production stock; (2) the production of maize in the country is not continuous throughout the year. Maize harvest usually takes place twice a year from February to April and July to September, so there is a vacuum of supply during October-January and May-June. On the other hand, the demand of maize for feed mill continues throughout the year; (3) buying maize in the international market would only relate to one international trader, while buying it in the country is associated with many farmers/producers.

Harvest area is one important component in calculating the production. The harvest area was reduced during 2012 - 2015. There are many factors that could cause the reduced harvest area, among others: the conversion of land, crop failure, and the traumatic factors of farmers to grow maize.

In order to increase national production to meet the national need, it is necessary for the government to provide stimulus to farmers such as stabilising the maize price at the farm level. The success to increase production could not be separated from the output policy where the central government has always encouraged local governments to accommodate the production of maize growers so that the price of maize at the farm level does not fall during harvest. Since 1990 the maize price was not set through the mechanism of the basic price, due to its ineffectiveness. The implication is that corn marketing follows the market mechanism, so that the maize price is determined by market forces, where the farmers' bargaining position is weaker than traders. Therefore, this study aimsat evaluating the response of maize farmers to changes in the consumer and import prices.

In the economic theory, supply is defined as a functional relationship that shows how much a commodity will be offered (for sale) at a certain place and time at various price levels, other factors are constant (Tomek W & Robinson KL, 1990). The supply curve shows a positive relationship between the numbers of commodities to be sold at a price level of commodities (Lantican, 1990). The supply curve above is based on the assumption that producers act rationally, which has always sought to maximize profits.

Based on these assumptions, the theoretical level of production will be pursued until the optimum condition is the condition where the value of the marginal product is equal to the unit price input.

Production decisions are taken at time t based on the current price (Pt) will not be realized at time t, but at time t + 1. Therefore, the supply function involves a variable grace period (lagged variable) as explanatory variables (explanatory variables) .But the greater the risk of a double collinearity between variables that grace period (Adnyana, 2000). One of the main characteristics of agricultural products is the lag time between planting and harvest, called the gestation period or time difference (lag). Thus the results obtained by the farmers are based on estimates of future periods and experiences in the past.

On the other hand, the concept is reflected in the response of the supply elasticity. The supply elasticity measures the responsiveness of quantity supplied to the variables that influence the value of zero to infinity. In general, the agricultural product has supply elasticity is less than one (tends to be inelastic). It is caused when demand falls, land, labor, and machinery intended for agricultural use not transferred quickly to a non-agricultural use. The opposite occurs for the opposite condition (Lipsey, 1995). Three common approaches used in calculating the supply elasticity, namely: (1) directly from the supply function, (2) indirectly, through a reduction in the elasticity of demand inputs and elasticity production, and (3) through the elasticity of the components of production (Tweeten, 1992). In response analysis deals on maize will be used the direct approach of the supply function.

If the supply curve describe the relationship between price and quantity assuming *ceteris paribus* or assume all other factors remain unchanged, deals response illustrates the output response to price changes by not holding other factors constant. In the economics, the supply response is defined as a variation of agricultural output and crop area in relation to price changes (Ghatak & Ingersent, 1984).

Most of previous research focuses on price and its effect on agricultural supply response. (Abebe, 2005) measures supply response with respect to own price and cross price of cereals in Ethiopia. (Mamingi, 1997) and (Nyairo et al, 2013) measured the impact of prices and macroeconomic policies on agricultural supply in developing countries. (Murova, Coble, & Trueblood, 2001); and (Leaver, 2003) measured responsiveness of agricultural output for Ukrainian and Zimbabwean farmers respectively to price but did not consider any market factors.

Usman et al (2013) and Oladejo et al (2012) measures supply response of maize with respect to own price and cross price of cereals in Nigeria. Most supply response studies in the past have been based on the (Nerlove, 1956) odel of adaptive price expectations and partial output (area) adjusment (Oliyade, 1972) (Garba, Kwanashie, & Ajilima I, 1998). However, this model has been widely criticised because of its ad hoc assumptions and a possibly of giving rise to spurious regressions as a result of the use of non-stationary time series. Consequently, the present study uses the method of cointegration and its implied error correction model to overcome the problems usually encountered with the use of the traditional Nerlovian model.

Study about the maize supply response in Indonesia has been researched. Agustian and Hartoyo (2012) researched the suply response of maize by using multi input and multi output method. The result showed that supply elasticity of maize to price change both in East Java and West Java Province is elastic, while the change of input price: seeds, urea, TSP and labor is inelastic. Input demand elasticity: seeds, urea, and TSP are inelastic to the price change itselfs. Maize research expenditure has a positive effect on masize supply both in East Java and West Java, with inelastic elasticity. While the road infrastructure has a positive effect to maize supply in both province with the value of elasticity is elastic.

The results of Siregar's (2009); Sitinjak (2015) and Pangestika et al (2015) research show that factors affecting the area of maize harvest are maize price, soybean price, cassava price, rainfall, land conversion, interest rate and total area growth irrigated. Whereas, based on estimation of maize productivity response, factors that significantly affect maize productivity are maize price, previous year's productivity, farm laborer wage, urea fertilizer price, and seed price. The result of Siregar's research (2009) showed that maize supply response to maize price in short term is inelastic and positive in value, that is 0,3903, whereas in long term is elastic, that is equal to 1,0538.

Natsir (2015) and Agustian (2012) state that the increase in the price of corn imports and prices feed can affect the increase in corn harvested area, while the increase in rice prices and price cassava can affect otherwise. The increase in the price of corn, the price of seed corn, and the price of TSP fertilizer could affect the improvement of productivity of corn, on the contrary, an increase in the falling corn price of previous maximum price, and prices of urea fertilizer can affect a decrease in productivity of corn. Farmers are less responsive to price changes if associated with corn harvested area, but if associated with corn productivity of the farmers (especially in Central Java) is very responsive to price changes. Total supply of corn in the lagged period has always responded positively by corn farmers in Indonesia. El Niño climatic anomalies can affect in a decrease in corn harvested area, especially in Central Java and East Java.

In East Java, Central Java and Lampung, intensification policies (BLPB) and irrigated land area can be a positive influence to the level of productivity of corn; Elasticity of corn supply in Indonesia is inelastic to the price of corn, but in the long run is more elastic, due to the adjustment of farmers habits. The behavior of corn farmers in Indonesia are more elastic in productivity rather than the harvested area. Elasticity of corn supply in South Sulawesi is the most elastic, but have the longest supply response. By contrast, in Central Java, corn supply elasticity is less elastic, but have the fastest supply response.

Furthermore, Bachtiar's research et al (2014) showed that producerprice of corn has significant influence on the expected producer price of corn and the estimation of expected price equation shows that price volatility is persistent. Fertilizer price, retailer price of corn, producer price of rice and the expected variance of corn producer price have less influence on corn supply response. While, productivity t-1, planted area, and expected producer price of corn have more influence on the corn supply response.

Based on the above studies, maize demand in Indonesia continues to increase together with increasing of population and demand for the national feed industry. But the increase in production is smaller than the increase in consumption so that the gap between production and consumption of maize is getting bigger (excess demand).The implication is that the price of corn continues to increase. The price change is not necessarily responded by farmers in Indonesia because as seen in Table 2 the maize harvest area has decreased. Therefore, it becomes important to explore the supply behavior of maize farmers in Indonesia in response to changes in domestic and import prices. Based on these problems, the purpose of this study is to analyze the supply response of maize farmers toward the changes of maize price in Indonesia using Error Correction Model (ECM).

RESEARCH METHODS

The research uses secondary data. In order to analyze the supply response of maize toward the change of domestic and import prices, the annual time series data from 1980 to 2016 is used. The annual data type such as production data, the harvested areas, the price of domestic maize kernel, the price of imported maize, price of rice, the price of urea, wage of labor, animal feed prices and the number of imported maize.

The method used in analyzing the supply response is ECM. The analysis procedure is as follows:

a) Stationeritas or Unit Root Test

The first step that should be taken in the estimation of the economic model with time series data is the stationary data test, which is also known as stationary stochastic process. Stationary is needed to avoid spurious regression. An equation is said to be stationary if it has a mean, variance and covariance *t*hat constant at any lag and does not contain a unit root. Test stationary in this data can be done by using Augmented Dickey-Fuller (ADF) to the same degree (level or different) to obtain a stationary data, data variance are not too big and has a tendency to approach the average value (Enders, 1995).

(Widarjono, 2012) explains that the function of the ADF test is to see whether there is a trend in the movement of data to be tested. ADF test consists of a regression calculation which is formulated as follows:

$$\Delta Y_t = \gamma Y_{t-1} + \beta_i \sum_{t=1}^{\rho} \Delta Y_{t-i} + \varepsilon_t \qquad (1)$$

$$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \beta_i \sum_{t=1}^{\rho} \Delta Y_{t-i} + \varepsilon_t \quad \text{...(2)}$$

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \gamma Y_{t-1} + \beta_i \sum_{t=1}^{\rho} \Delta Y_{t-i} + \varepsilon_t \quad \text{...(3)}$$

where

ΔY_t : The difference variable (Y_t - Yt-1)

γ : (ρ-1)

$\alpha_0, \alpha_1, \gamma, \beta_i$: Coefficient

t : Time Trend

Y : Stationary tested variable (variable outside the area of the maize harvest, the productivity of maize, the price of domestic maize (Rp/kg), the price of maize imports (Rp/kg), rice price (Rp/kg), the price of soybeans (Rp/kg), the amount of imported maize (tonnes), the price of urea (Rp/kg), labor (Rp/HKO), and animal feed prices (Rp/kg).

P : length of lag used in the model;

ε : error.

The difference equation 1. with two other regression are entering constants and variables *trend.* Equation 1. used on observational data that it is assumed only have a slope, do not have constant and *trend.* Equation 2 is used with the assumption that observation data have constants and intercept. Equation 3 is used when the observation data are assumed to have a component constants, intercept and trend. The hypothesis of this test is H_0 if γ = 0 means the time series data contains a *unit root* that is not stationary and H_1 if γ <1 means that the data is stationary.

Eviews 7 application program is used to categorize the data which stationary or not by comparing the value of Mackinnon critical with an absolute value ADF's statistic. If the stationary test shows ADF's statistic value is greater than the Mackinnon critical value, it can be seen that the data is stationary because it does not contain unit root. Conversely, if the value ADF's statistic is smaller than the Mackinnon critical value, it can be concluded that the data is not stationary at the degree level. Thus, differencing the data to obtain a stationary data at the same rate in first different *I* (1) must be done by reducing the data with the previous period data (Ajija, Setianto, Setianto, & Primanti, 2011).

b) Determination of Optimum Lag

Further, to determine the optimal lag number used in the Stationary test, according to (Enders, 1995). The following are the criteria used:

Akaike Information Criterion (AIC): T log | Σ | + 2 N .... (4)

Schwarz Bayesian Criterion (SBC): T log | Σ | + N log (T) ....(5)

Where:

T : The number of observations

| Σ | : The determinant of the matrix of the variance/covariance of residual

N : number of parameters to be estimated

in determining the optimal lag by using the information criteria, the selected criteria are criteria that have a number of AIC and SBC is the smallest among the different lag is recommended. When the smaller value of these criteria, the expected value generated by a model would be closer to reality. Whereas if several criteria are used then there are additional criteria are *adjusted* R^2, VAR system. Long optimal inaction occur if the *adjusted* R^2 is the highest. Determination of the interval or lag optimal an important stage in the ECM approach. The length of the interval or optimal lag of variables needed to capture the influence of other variables (Widarjono, 2012).

c) Johansen Cointegration Test

The aims of cointegration test to determine whether the variables are not stationary cointegrated or not. Cointegration concept proposed by Engle Granger as a linear combination of two or more variables are not stationary and yield variables are stationary. This linear combination is known as cointegration equation and can be interpreted as a long-term equilibrium relationship between variables (Firdaus, 2011). Cointegration testing in this study using the approach of the Johansen test. Johansen test is conducted by comparing the value of *the trace statistic* with the *critical value* and a *maximum eigenvalue* with *critical value* at 5% significance level. If the *trace statistic* or the *maximum eigenvalue* is greater than *critical value,* the indicates that the system of equations there is a long-term relationship or cointegration. The test will be done is *trace test* which measures the number of cointegration vectors in the data using rank cointegration matrix Test expressed as follows (Enders, 1995):

$$\lambda_{trace\ (r)} = -T \sum_{t=r+1}^{n} \ln (1-\lambda_t) \quad (6)$$

$$\lambda_{max\ (r,\ r+1)} = -T \ln (1-\lambda_{r+1}) \quad (7)$$

where:

λ_t : the value of alleged root characteristic *(eigenvalues)* are obtained from estimation matrix π

T : number of observations

r : rank which indicates the number of vector co-integration

In the λ *trace* test, H_0 is the number of co-integration vectors missing ≤ r as a common alternative. If the λ *trace* < λ *table* then accept H_0, which means co integration occurs at rank r. While at λ max test, H_0 is the sum of co-integration vector = r is the alternative of co-integration vector r + 1 (Enders, 1995) In the use of Eviews 7, decision-making is done by looking at the value of *the trace statistic* and *critical* value. If the *trace* statistics > *critical value,* the equation is cointegrated. Thus H_0 = non-cointegration with the alternative hypothesis H_1 = cointegration. If the *trace* statistics > *critical* value, then reject H_0 or accept H_1, which means there is cointegration. If there is no cointegration between variables we used the model VARD (VAR *in* difference), whereas if the data are suspected in the VAR model cointegration, VAR model used is a model VECM *(Vector Error Correction* Model) (Firdaus, 2011).

d) Error Correction Model (ECM)

Supply response for certain commodities in this study was approached by the response of harvest area and productivity. The reason is that the use of crop area and productivity as dependent variables can be easily determined or controlled by the farmer (Nerlove, 1956); (Askari & Cummings JT, 1977). Furthermore, the farmer's decision in determining the harvest area and the level of productivity is a direct reflection of farmers' response to price changes.

The independent variables were used to predict the supply response of maize, based on the research of (Adnyana, 2000), in response to the area of the rice harvest, it is stated that the price of rice is influenced positively by the rice harvest area, negatively by competitors' commodity price (maize) andextensive conversion of land, positively by the area under irrigation, positively by rainfall and harvest area of the prior period. For productivity responses, it is stated that the price of rice has positive influence on the productivity of rice, fertilizer use has a positive effect, input prices (wages) have negative effect, and the productivity of the prior period has positive effect. (Puspadewi, 1998) analised how much is the influence of the increase in maize price, alternative commodity prices and input prices as well as differences in location and technology trends on the response of area harvested and productivity of maize in East Java and Central Java by using a partial adjustment model Nerlove. Research (Siregar, 2009) analised the supply response of maize in Indonesia using Nerlove models. Variables that affect the maize crop area are the maize price, prices of competitors (rice, soybean, cassava and peanuts), the growth rate of land conversion, the total growth of irrigated areas, rainfall and harvest area of earlier period.

Due to its advantages in combining the effects of short-term and long-term, the ECM become a model that can explain the explanatory variables. ECM equation to estimating harvest area are:

$$DlnLJG_t = \alpha + \beta_1 LnPJG_t + \beta_2 LnPMJ_t + \beta_3 LnPPD_t + \beta_4 LnPPAK_t + \beta_5 LnPKD_t + \beta_6 LnPUK_t + \beta_7 LnKL_t + \beta_8 LnCHJ + \gamma\ LnLJG_{t-1} + e_t$$

$$-1 < \gamma < 0$$

Where:

- $DLn\ LJG_t$: distinction first acreage of maize (Ha)
- $Ln\ PJG_t$: price of maize (Rp/kg)
- $Ln\ PMJ_t$: price of maize imports (Rp/kg)
- $Ln\ PPD_t$: price of rice (Rp/kg)
- $Ln\ PPAK_t$: price of feed (Rp/kg)
- $Ln\ PKD_t$: price of soybean (Rp/kg)
- $Ln\ PUK_t$: price of cassava (Rp/kg)
- $Ln\ KL_t$: growth of land conversion (%)
- $Ln\ CHJ_t$: average annual rainfall (mm / yr)
- $Ln\ LJG_{t-1}$: crop area of maize previous period (Ha)
- γ : *Error correction term*

while the response function offers through productivity approach is known as follows:

$$DlnYJG_t = \alpha + \beta_1 LnPJG_t + \beta_2 LnBNH_t + \beta_3 LnPUR_t + \beta_4 LnUTK_t + \beta_5 LnCHJ_t + \beta_6 LnPPAK_{t-1} + \gamma\ LnYJG_{t-1} + e_t$$

$$-1 < \gamma < 0$$

where:

DLN YJG_t	:	distinction first productivity of maize (kg/ha)
Ln PJG_t	:	price of maize (Rp/kg)
Ln BNH	:	price of seed (Rp/kg)
Ln PUR_t	:	price of urea (Rp/kg)
Ln UTK_t	:	wage of labor (Rp/HOK)
Ln CHJ_t	:	average annual rainfall (mm/yr)
Ln $PPAK_t$	:	price of feed (Rp/kg)
Ln LJG_{t-1}	:	the productivity of maize previous period (kg/ha)
γ	:	Error correction term

To determine whether the model specifications is valid, the ECM then tested against coefficient *Error Correction Term* (ECT). If the test results of ECT coefficient is significant, then the observed model specifications is valid.

RESULTS AND DISCUSSION

The supply response analysis of maize farmer toward price changes can be seen from both the response of harvest area and the response of maize productivity in Indonesia. The result of model estimation of ECM is the best model that is obtained with economic and econometric criteria consideration. Economic criteria refers to the sign coefficient which has been in accordance with economic theory. While the criteria for evaluating econometric statistical constraints by using statistical tests.

Based on the statistical test result that this model has a coefficient of determination (Adj R^2) in order to measure the good of fit. The regression results 0.801 for crop area of maize and 0.894 for maize productivity response. As for the other criteria like symptoms multi collinear and auto correlation not occur in the model. The estimation result of crop area of maize can be seen in Table 3.

Table 3. Estimated Response Area of Maize in Indonesia

Variable	Coefficient	t-Statistic	Prob.
Constant	0.116	0.689	0.507
Price of maize	0.935	3.321	0.003***
Price of rice	-0.259	-0.669	0.509
Price of soybean	-0.401	-2.180	0.038**
Price of Imported maize	0.076	1.935	0.063*
Price of feed	0.375	2.329	0.030**
Rainfall	-0.012	-0.169	0.868
Price of Cassava	-0.135	-1.639	0.113
Growth of land conversion	-0.108	-5.316	0.000***
Crop area of maize previous period	0.355	1.715	0.095*
ECT	-0.676	-1.737	0.097*
R-squared	0.823	F-statistic	6.873
Adjusted R-squared	0.801	Prob(F-statistic)	0.000
Durbin Watson Stat	1.981		

Source : Pusdatin (2016), processed
Note : Specification table:* significant at the 10% significance level, ** significant at the 5% significance level, and *** significant at 1% significance level

Based on the analysis of the ECM in table 3 that domestic maize prices have a real influence on the level of 99%. The price of maize has a positive sign of 0.935. This shows that if there is an increase in the price of maize by 10%, farmers will respond by increasing the crop area of maize by 9.35%. The value of supply elasticity of area to the price of maize is positive dan inelastic, but is the most elastic if compared to another variables. The value of supply elasticity of price indicates that the response of maize farmer to the price is very large. The price of maize could be the benchmark for the farmeres in allocating cropping areas. The higher price of maize will encourage farmers to increase maize planting area, which in turn will expand the maize harvest area. This is in accordance with the research by Siregar (2009); Agustian and Hartoyo (2012); Natsir (2015), Sitinjak (2015); Madlul et al (2017) which stated that the price of maize could become a benchmark for farmers to increase the area.

Rice prices have no effect on the response toward maize crop area. This looks at the probability value that indicates a value of -0.259 (greater than 15% significance level). This is according to research (Siregar, 2009) which states that the price of grain has no effect on the planting area of rice due to differences in the cropping seasonal pattern between maize and rice, where maize will be planted during the dry season (planting III) while the rice will be planted in the rainy season (planting season I or II). Maize is often grown in dry land in the rainy season. In rain fed areas, the maize planted before and after rice, and maybe after that planted maize again. While on irrigated land is usually done cropping paddy-rice-maize. This indicates that the price of grain does not affect changes in crop area of maize.

Soybean prices showed a negative influence with a confidence level of 95% with a value of -0.401. This value indicates that soy is a commodity competitors or substitutes for maize. A value of -0.401 indicates that if there is an increase in soybean prices by 10% it will be responded by farmers to reduce the crop area of maize amounted to 4.01%.The value is inelastic which showed that despite greater increase in soybean prices, not all farmers respond by allocating land for planting soybeans. Facts on the field shows that farmers prefer to plant maize compared to soybeans for the production and the income derived from the cultivation of maize is higher than soybean cultivation.

The price of import maize also affects maize harvest area in Indonesia. This is indicated by the value of elasticity of 0.076 and the real effect on the confidence level of 90%. This value indicates that the elasticity value is positive, meaning that if there is an increase in the price of maize imports by 10%, then the farmers will respond by increasing crop area by 0.76%. This happens because the rising price of imported maize will reduce the amount of maize being imported, thus farmers will respond by increasing the crop area.

Animal feed prices have a positive effect with the elasticity of 0.375 at the 95% confidence level. This value indicates that if there is an increase in feed prices by 10% farmers will respond by increasing the maize crop area by 3.75%. Maize products are cultivated by farmers mostly to be used as input or feed, if the animal feed prices rise, farmers will try to increase its production by increasing the planted acreage. The price of livestock feed is inelastic to the response of maize area because maize is not only used for livestok feed, but also as an alternative food for rice.

Rainfall is not a determinant variable for farmers to increase or reduce the crop area of maize. This is evident in the probability of no significant value. This is because the rainfall in the last few years cannot be predicted, but farmers still cultivate maize in accordance with the existing cropping pattern. Farmers will plant maize as annual cropping pattern that is commonly practiced by farmers without depending on rainfall except in the rain fed areas.

The influence of cassava prices is a variable that has no effect on maize crop area. This is seen in the insignificant probability value. Cassava can be a substitute product for maize commodities in terms of land competition, but in Indonesia, cassava farmers are relatively fewer than rice and maize commodities, so cassava is not a determinant for maize land area development in Indonesia.

ECM analysis result shows that variable of land conversion growth proved to have a significant affect at the significant level of 1% and have the appropriate marks with economic theory that is equal to -0.108. the value indicates that an increase in the rate of land conversion by 10% will decrease the planting area of maize commodity in Indonesia by 1.08%, ceteris paribus. The rate of agricultural land conversion is increasing every year, especially in Java Island. Sumaryanto (1994) in Siregar (2009) explained that if a location occurs agricultural land conversion, soon the surrounding land will be converted and its nature tends to be progressive. Assuming that there is no development of maize through extensification of potential lands such as irrigated and unused rainfed fields in dry season, and rain-fed rice fields or unused tidal land for agricultural business, particularly on the island of Sulawesi, Sumatra, Kalimantan, and Irian Jaya, the increase in land conversion will lead to a decrease in the area of maize.

Variable of area of the previous year has a positive effect in accordance with the theory even though the variable is not significant. This is because each year, the maize crop area is likely to fluctuate. Maize is an annual plant that can compete with other commodities so that the area planted with maize also fluctuates. Therefore, the previous year's crop area of maize is not the standard for farmers to determine the next year's crop area of maize because the changes can be responded quickly by the farmer in the same year.

After the discussion about the supply response of maize based on harvested area of maize, the next to be discussed is the supply response of maize in Indonesia based on the productivity of maize in Indonesia. The supply response based on the maize productivity can be seen in Table 4.

Table 4. Response Estimation Results Productivity of Maize in Indonesia

Variabel	Coefficient	t-Statistic	Prob.
Constant	9.034	1.827	0.078
Price of maize	1.095	5.001	0.000***
Price of seed	-0.311	-1.931	0.063*
Price of feed	0.069	2.402	0.023**
Price of urea	-0.248	-1.710	0.105
Rainfall	-0.098	-2.753	0.009***
Wage of labor	0.073	1.778	0.090**
Previous period of Maize productivity	0.120	1.221	0.232
ECT	-0.623	-3.420	0.002***
R-squared	0.901	F-statistic	6.441
Adjusted R-squared	0.894	Prob(F-statistic)	0.000
Durbin Watson Stat	2.022		

Source : Media Center, 2016 (processed)
Note : Specification table:* significant at the 15% significance level, ** significant at the level of real 10%, and *** significant at 1% significance level

Based on supply response estimation using the ECM model, there are several variables that influence maize productivity which are the price of maize, the price of seed, the price of feed, rainfall and labor costs. While the variable price of fodder and maize productivity in the previous period does not affect the productivity of maize.

Table 4 shows that the variable of maize price is affecting the productivity of maize in Indonesia. It is known based on coefficient value of 1.095 with a confidence level of 1%. The coefficient values indicate that an increase in the maize price by 10% will increase maize productivity by 10.95%. This is consistent with the theory, that an increase in the corn pricewill give farmers an incentive to increase production by encouraging an increase in productivity of maize. Farmers will try to manage the farm with the best corn when corn prices are relatively high in order to get better income.

The price elasticity of supply is elastic and most elastic compared to other variables. This indicates that the response of maize farmers to price changes is very strong. Therefore, changes in maize prices will largely determine the policy of maize development in Indonesia. This result is consistent with Agustian and Hartoyo's (2012) and Onono's et al (2013) research indicating that the elasticity of maize supply to price itself is elastic indicating that farmers are highly responsive to changes in maize prices in order to increase maize supply. However, the results of this study contrast with the results of Suryani's et al (2015) study which shows the effect of changes in rice prices on rice supply was more elastic than maize supply. This is expected due to the influence of government purchasing price (HPP) for rice commodities, while for maize commodity, the selling price of the product fully follows the market price. There is no government intervention that regulates the selling price of maize.

The elasticity of input supply to the input price (seed and urea fertilizer) is inelastic and negatively indicated, respectively -0.311; -0.248. Seed input prices have a significant effect on maize supply. Prices of maize seeds in Indonesia tend to be expensive that can reach the price of Rp. 60.000/kg to Rp. 100.000/kg. The increasing price of seeds in maize farming, caused by the multinational corporations that control the maize seed in Indonesia. The influence of negative input prices in accordance with the Research of Suryani et al (2015) and Agustian and Hartoyo (2012) Changes in input prices affect negatively to the supply of rice, maize, and other crops.

Variable price of urea has a negative sign and not significant at the 90% confidence level. Urea fertilizer price elasticity is equal to -0.248. This value is consistent with the theory that there where if an increase in the price of urea fertilizer, farmers will respond by reducing the amount of urea used and will have implications on the resulting decline in maize productivity. The main input prices fertilizer prices is an important variable that determines the productivity of maize. Facts on the field shows that the price of urea relatively high with the rare availability. This condition make the maize farmer reduce the urea usage that can be imply the decreasing of productivity.

The price of livestock has positive effect on maize supply in Indonesia. The value of supply elasticity to livestock feed is significant at 5% level. Elasticity value of 0.069 indicates that the increase of livestock feed by 10% will increase the supply of maize at 0.69%, ceteris paribus. This indicates that the enhancement price of livestock feed will give incentives for farmers to increase supply of maize despite the influence of the price of livestock feed are not too elastic.

Rainfall variables have coefficient on -0.098 and significant at 1% significant level, which means that the increase of rainfall at 10% will decrease the supply of maize at 0.98%, ceteris paribus. Maize crops are mostly grown in the dry season or when the level of rainfall is low (maize crops require an ideal rainfall of about 85-200 mm/month). So when the level of rainfall increases the maize supply in Indonesia will decrease. The result is represented in the Siregar (2009), dan Natsir (2015) research, that climate variable influences the supply maize in Indonesia. This is also in accordance with Blanc's (2013); Ibitoye and Shaibu (2014) studies which shows climate variable like rainfall and temperature impacts on crop supply.

Wage of labor variable affects maize productivity significantly on the error level at 1%. Labor has a positive sign of 0.073 which is not consistent with the hypothesis or theory. The value indicates that if an increase in wages by 10%, then the productivity of maize will increase by 0.73%. This happens because most of the relatively small scale of maize farming, which is less than 0.5 hectares per family in Java and over 1 hectare per family outside of Java (Susilowati & Maulana, 2012; Suryani *et al.* 2015). In addition, maize cultivation is not *labor intensive* so that the increase in wages was able to increase the productivity of maize. As an illustration, human labor to manage maize farming in a dry land area is 64 HOK men and 45 HOK women per hectare (Djulin, Syafa'at, & Kasryno, 2002). Therefore, the increase in wages will not reduce the amount of labor used. With the amount of labor that is relatively fixed despite the wage is raised, then the peasants will be more active or more have an incentive to plant more corn intensive. While the price of corn feed and productivity of the previous year did not affect the productivity of corn at this time. High feed prices neither have no direct influence on the productivity of maize, meanwhile, the productivity of maize fluctuates nor a standard to improve the productivity of maize in the next period.

In order to discuss the supply response of maize in Indonesia, it is first necessary to calculate the value of maize in Indonesia supply elasticity in both the short and long term. Table 5 shows that the elasticity of the corn harvest area and productivity of the maize price in the short term and the long term have a positive sign. That is, the increase in corn prices will increase crop acreage and productivity of maize in the short term and in the long term. The value of long-term elasticity has a relatively greater value than the value of the short-term elasticity. The value of elasticity out of maize area in a short term tends to be inelastic but in a long term is elastic. In addition, the elasticity of maize productivity tends to be more elastic than the elasticity of land area. This is in accordance with Natsir's (2015) and Siregar (2009) studies which suggest that Indonesia's maize supply elasticity, generally inelastic to the changes in maize prices, but in the long term is more elastic because of farmers habit adjustment. The behavior of Indonesian maize farmers is more elastic on productivity than harvested area.

Table 5. Response (Elasticity) Offer Corn Against Price Change in Indonesia in the Short and Long Term

Description	Response of maize harvest area to price of maize (*eAP*)	Response of maize productivity to price of maize (*eYP*)	Supply response of maize to price of maize (*eQP)*
Short term elasticity	0.935	1.095	2.03
Long term elasticity	1.449	1.244	2.69

Description: *EAP + EYP = EQP*

This suggests that a greater response in the long term is due because theoretically, farmers have the opportunity to make adjustments in their production process, so responsive to price. In addition, the price of maize is expected to continue to rise in the next few years given the rapid demand for corn as raw material for food, feed, and bio ethanol, as indicators for farmers to increase production. Thus, it can be inferred that increasing the land area (extension) and/or increasing productivity (intensification) are two strategies that can be implemented to increase the supply of corn and to achieve self-sufficiency in maize in Indonesia.

Based on the analysis of the maize supply response as described above, there are some suggested strategies for achieving corn self-sufficiency in Indonesia:

a. Pricing Basic Corn

Results of the supply response analysisindicate that maize farmers in Indonesia are responsive to price changes. They results indicate that outside area elasticity and output price elasticity of supply is the most elastic compared to the value of elasticity of other variables. Therefore, to encourage farmers to produce maize, the government should implement a price basic policy, because the price variable is significant in the response or responses harvest area of maize productivity. However, if the policy of the base price for maize will be set back, this policy should be implemented effectively. This will certainly encourage farmers to increase corn production as the price is guaranteed by the government.

b. Corn Productivity Enhancement (Intensification)

In addition to applying the basic price of the return policy, the analysis result shows that the elasticity of short-term and long-term response to the productivity of maize prices is positive. Therefore, Itcan be used as the basis, that when the corn price increases, efforts to increase the maize supply (production) are better directed at improving its productivity (maize crop intensification).

c. Expanding the Corn Planted Area (extensification)

As the response elasticity of the maize harvest area is positive in the short and long term, efforts to increase maize production can be done through the extension. In order to attain self-sufficiency, especially maize, the government could expand maize planting area (extensification). Extending the plant aims at increasing production of a commodity through the expansion or addition of planting area. Expansion of the maize planting area can be done by optimizing the raw comprehensive and addition of dry land both in Java and outside Java. In addition, the extensification of crop area can be done in the forestry government area (Perhutani) by planting maize between the main crop (tree), and extensification can be done by using sub optimal land area (peat land and swamp area) and other unproductive land.

CONCLUSIONS AND POLICY RECOMMENDATION

The price of maize has a positive sign on the crop harvest area and the commodity's productivity. The price of maize can be a reference for farmers in allocating the planting area. The higher the price of maize, it will encourage farmers to expand the planting area which will eventually expand the harvest area. In addition, if there is an increase in the price of maize, then farmers will have an incentive to increase production of maize. If the price of maize is relatively high, there are opportunities for farmers to get better income, so usually they will try to manage their maize farms as well as possible.

The price of soybean commodity also affects the planting area for maize. The increase in soybean price will cause the reduction of corn area although relatively small. The price of imported maize will be responded positively by the farmers, if the price of maize increases, farmers will increase the area of maize. While the price of poultry feed is also a determinant factor of corn planting area because most of the corn produced will be used as inputs of animal feed.

In addition to the price of maize, other factors that affect the productivity of maize are the price of seed, urea fertilizer and labor wage. The price of seed and urea fertilizer are negatively responded by farmers. The increase of seed and urea fertilizer price will reduce the use of seed and urea fertilizer which has implication on decreasing mazie productivity. Labor wages are positively responded by farmers because corn farming is not a labor intensive and though labor costs increase, the use of permanent labor could still increase maize productivity .

Livestock feed prices have a positive effect on maize supply in Indonesia. Increased livestock feed prices will provide incentives for farmers to increase maize supply despite the influence of livestock feed prices are not too elastic. In addition, rainfall variables have negative coefficient and significant which indicate that high rainfall will reduce maize supply because maize crop is planted more at low rainfall.

Based on the estimation result, the influence of maize price is very significant in influencing the planting area and the productivity of corn, therefore the basic price policy can be re-introduced to increase the motivation of farmers to cultivate corn. The government's efforts to improve maize supply is to increase the price of maize in Indonesia or by imposing the floor price policy. Although input prices such as seeds, fertilizers and labor wages increase, but if output prices increase, the production of maize can still increase. Because of this, it requires price stability policy and increase of maize price. However, to encourage enhancement of maize supply, it is necessary to apply the subsidy policy for farmers in the form of input subsidy or subsidy of interest on venture capital, considering that the majority of maize farmers in Indonesia are marginal with small land area and limited capital.

In order to attain self-sufficiency, especially maize, the government could expand the maize planting area (extensification). Extending the plant is to increase production of a commodity through the expansion or addition of planting area. Expansion of the maize planting area can be done by optimizing the raw comprehensive and addition of dry land both in Java and outside Java. In addition, the extensification of crop area can be done in the forestry government area (Perhutani) with maize planted between the main crop (tree) and extenfication can be done by using sub optimal land area (peat land and swamp area) and other unproductive land.

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