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RESEARCH ARTICLE

ESTIMATION OF PROFIT FUNCTION AND SUPPLY RESPONSE OF CORN COMODITY IN JAMBI PROVINCE – INDONESIA

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ABSTRACT

This research aims to; [1] Analyze the profit function and supply response of corn comodity, [2] Analyze the impact of changes in inputs and outputs to change output supply of corn commodity. This research uses time series data of structure costs from 1990-2016 of corn production in Jambi Province. While estimation of profit function and offer response of output supply with the translog profit function model approach. And the scenario of corn commodity development policy by simulating the estimation model, the result of the research show that ; output supply [corn] is not only affected by the price itself but also affected by the price of input used. Output Supply behavior affected by the price itself and input price. Corn supply elasticity to price itself is elastic. Input demand is not only affected by the input price itself and other input but also affected by the price of the corn produced.Behavior of demand for urea fertilizer input affected by the price itself, TSP fertilizer prices and corn prices. The elasticity of urea fertilizer demand for the price of the fertilizer itself is inelastic.

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INTRODUCTION

Corn needs in Indonesia is quite large, that is 13, 8 million tons in 2016. The need is divided into two parts, for industry of feed with total demand reaching 8.6 million tons and for food with a total demand of 5.2 million tons. This need is increased compared to 2015 is 13.1 million tons. With 8.3 million tons for the industry of feed and for food consumption with a total of 4.8 million tons (Wicaksono, 2017). The national harvest area in 2017 is 5.3 million Ha, with the number of production is 27,95 million tons and the productivity is 52 Kw Ha^{-1}. For Jambi area, there are 12,136 Ha of corn planted with productivity of 4, 3 ton Ha^{-1}. Jambi Province in 2010 planted area is 8,760 Ha with productivity of 3,7 Ton/Ha, while in 2017 planted area increased to 11,651 Ha with productivity of 6,1 ton Ha^{-1}. The increase has occurred because of the special efforts made by the government through assistance in production facilities that are expected to increase productivity and increase cropping intensity. Effort of national corn production should go through by providing incentives output price to corn farmers. Implementation of policies always opposites between the interests of producers and consumers, this can be seen from the reality in the field that corn prices are often low and tend to be pressed unilaterally by the manufacturer / trader, did not give enough stimulation to farmers for using better production technology, so that productivity is still low. Low corn prices also do not motivate farmers for planting corn in a wider area. According to Kasryono *et al.* (2008) that the success of increasing production is also inseparable from the central government's output policies that always encourage local governments for accommodate farmers' corn production so the price of corn at the level of farmers does not fall at the time of harvest. As known, there is no rules for price of corn so the price of corn is determined by the market mechanism. This market mechanism will create the expected competition between traders that can give the benefit for farmers. The behavior of production optimization can be done in two ways, there are: first maximization, is trying to obtain the maximum level of production from the use of certain costs (constrained output maximization), and second minimization, is produce a specific result using the smallest cost (constrained cost minimization) This optimization principle can also be done by maximizing profits in producing a particular result. This research used the translog profit function model approach, because this approach has several advantages, including (1) Input and Output of production are analyzed simultaneously, with its destiny profit function then the function of input demand and output supply can be known simultaneously without having to make an explicit production function, (2) use a price measure for the variables reviewed, so that it has conformity with the reality of the role of prices in the market in the decision to use production inputs. In this regard, as for the purpose of research

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is (1) Analyze the profit function and supply response of corn comodity, (2) Analyze the impact of changes in inputs and outputs to change output supply of corn commodity.

MATERIALS AND METHODS

This research was held in Jambi Province. Site selection is done purposively because Jambi Province is the center of corn production outside Java which has the potential land for corn development and profitable market opportunities. Data collected was time series data from 1990-2016.

Method of analyzing translog profit functions

Transcendental profit function logarithm (translog) introduced by Cristiansen, Jorgenson dan Lau dan Yotopoulos (1972), Hartoyo (1994) and Adeleke *et al.* (2008).The translog profit function is normalized by the output price (corn) and restricted so that $\gamma_{ih} = \gamma_{hi}$.The translog profit function model in this research are follows:

$$\ln\pi^{*} = \alpha_{o} + \sum_{i=1}^{4} \alpha i \ln R_{i^{*}} + 0.5 \sum_{i=1}^{4} \sum_{h=1}^{4} \gamma_{ih} \ln R_{i^{*}} \ln R_{h^{*}} + \sum_{i=1}^{4} \sum_{h=1}^{4} \gamma_{ih} \ln R_{i^{*}} \ln Z_{k} + \sum_{k=1}^{4} \beta k \ln Z_{k} + 0.5 \sum_{k=1}^{4} \sum_{j=1}^{4} \lambda kj \ln Z_{k} \ln Z_{j} \quad (1)$$

Where:

π^{*} =Restricted profits (*TR –TVC*) which normalized with the price of corn. Farming profit units are per MT

R_i^{*} = Price of variable inputs to i; i= 1,2,3,4 successively seed prices (R_s), urea fertilizer prices (R_{UR}), TSP Fertilizer Prices (R_T), and wages of human labor (R_w). The fourth unit of the variable input prices, the price of seed: Rp/kg; fertilizer price: Rp/kg; and labor wages: Rp/HK

Zk = Fixed input to k; k=1,2 successively: other costs (Z_1), corn harvest area (Z_2)

α_o = Constant

$\alpha_o\alpha_o\gamma_{ih}\delta_{ik}\beta_k\Phi_{kj}\lambda_l$ = Estimated profit function parameters.

Maximum benefit can be achieved by assuming meet requirements- symmetry, homogeneous to the input and output, monotony, convexity. To qualify symmetry, it must be $\beta_{ij} = \beta_{ji}$ for $i \neq j$. Functions advantages of homogeneous linear first-degree and zero degree to share function of variable costs. The monotony can be fulfilled if the estimated value of the revenue share (S_i) have a positive sign and the estimated value of the share costs (S_h) have a negative sign.

Function of Output Supply and Elasticity of Supply

According to Rusastra (1995) factors output supply (faktor-faktorpenentupenawaranterhadap output), are: (a). Output price itself (b). Prices of other related commodities (c). Input production price. Elasticity of output supply can be expressed as follows:

a. Elasticity of supply (penawaran) to variable input price to – i are :

$$e_{vi} = - S_i^{*} - \sum_{i=1}^{n} \gamma_i / [1 + \sum_{i=1}^{n} S_{i^{*}}] \quad (2)$$

b. Elasticity of supply to price itself as follows :

$$e_{vv} = \sum_{i=1}^{n} S_{i^{*}} - \sum_{i=1}^{n} \sum_{h=1}^{n} \gamma_{ih} / [1 + \sum_{i=1}^{n} S_{i^{*}}] \quad (3)$$

c. Elasticity of output supply to fixed input Zk:

$$e_{vk} = \sum_{i=1}^{n} \delta_{ik} \ln Pi + \beta ik - \frac{\sum_{i=1}^{n} \delta_{ik}}{[1 + \sum_{h=1}^{n} S_{h^{*}}]} \quad (4)$$

Analysis of changes in prices and outputs policy

Simulation of policy to analyze the impact of government policy on input demand and output supply used a simple model of linear elasticity by Fulginiti and Perrin (1990), the elasticity models used are:

$$\begin{bmatrix} \delta lnQ \\ \delta lnx \end{bmatrix} = [E] \begin{bmatrix} \delta lnP \\ \delta lnR \\ \delta lnZ \end{bmatrix} \quad (5)$$

Where:

δlnQ = vector (k+n) x1 change of output

δlnx = vector (k+n) x1 change of input

E = matrix (k+n) x (k+n+m) elasticity of supply and demand to output price, input price and fixed factor

$\delta lnP \delta lnR \delta lnZ$= vector (k+n+m) x1 change of output price, input price and fixed factor

Change of policy that will be analyzed include several scenarios:

1. Corn prices went up to 15 percent
2. Corn prices fell to 15 percent
3. Fertilizer price went up 15 percent
4. Seed price went up to 20 percent
5. Combination of scenario policy : 1,3, and 4
6. Combination of scenario policy : 2,3, and 4

RESULTS AND DISCUSSION

Statistical testing and production requirements

According to Koutsoyannis (2005) that strength of multicolinearity can be measured with VIF (variance inflation factor). If value of VIF above 10, then there is a problem of multicolinearity, and if < 10 there is no problem of multicolinearity. The test results on r^2 system with SUR method (system of $R^2 = 0.7826$) VIF values obtained of 3.51. The result of regression with OLS, r of average correlation value still below 0.8. This is as revealed by Koutsoyannis (2005), if correlation of R between independent variable below 0.8 then there is a problem of multicolinearity. Another statistical test is autocorrelation. The test performed to see autocorrelation of the value of Durbin Watson (DW). Value of DW obtained ranges 0.48-1.27. The acceptance limit of the null hypothesis, which states that there is no autocorrelation at the 5 percent real level is between 1.15-2.38. It can be concluded that the equation of the translog profit function and variable cost share equation do not have autocorrelation problems. In estimating the translog profit function with the normalization of profits by the output price, will be able to fulfill the function of homogeneous degree one advantage. The result of test also prove that testing of production requirements for homogeneity, symmetry, monotony and convexity can be fulfilled.

The result of translog profit function

The estimation results of translog profit function with SUR method can be seen in Table 1. The estimation results of

translog profit function and the share variable costs obtained R^2 are 0.7826. This means that the variables included as explanatory variables can explain the profit function variable and the share of variable costs are 0.7826 percent. Based on the estimation of profit function parameters as shown in table 1, t-statistic test as much 16 parameters significantly different at the level of 1 to 10 percent. From the results of the estimation of translog profit function can be seen that, of all the variable input prices is negative. All input price variable was statistically significant at level 1 and 10 percent. This implies that in case of rise in price of all input variables will reduce the profits of farmers. Corn seed prices tend to increase from 1990-2016 to 17.34 percent per year. Labor wages also increase in the period 1990-2016 by 18.56 percent per year. Increasing wages of labor due to the increasingly competitive labor market, as a result of the increasing number of population, especially in working age. For fixed input variable except other costs like harvested area, are positive sign. This means that the fixed factor has increased so that the profits of corn farming will increase. The harvest area is real at the level of 10 percent and has a positive effect on profits, which means that if the harvest area increases then the farm profits will increase. The variable of price interaction alone for the variable input prices (seeds, urea, TSP and labor wages) has a negative sign. Especially for the variables of seeds, urea fertilizer and real labor at the level of 1 to 1 percent. This means that increasing variable input prices for seeds, urea fertilizer, TSP and labor wages will reduce the profitability of corn farming. Interaction between fixed input variables, namely land area, is positive. Furthermore, the interaction between variable input prices and fixed input variables generally has a negative sign.

Output elasticity and input demand for output prices and input prices

The result of estimating the elasticity of the supply of corn output includes the elasticity of supply to the input price and the elasticity of the price itself. In Jambi Province, the value of the elasticity of the supply of output (corn) to the price itself is positively significant at the level of 1 percent. The output elasticity of the price itself has an elastic value of 1.7891 percent (Table 2).On the production side the estimation of the value of the elasticity of input on its own price is in accordance with the law of demand and not too responsive (Inelastic).Farmers lack response if there is a change in the price of the production input. Cross-elasticity values that are significantly different mostly show substituted properties. This shows that the use of production inputs replaces each other in the event of a change in price. In the elasticity of input demand which is influenced by the output price shows a positive and elastic value, meaning that the increase in the price of corn tends to motivate farmers to use more input. The results of estimating elasticity of output offer indicate that the value of price elasticity itself is positive and inelastic which means that farmers will increase (decrease) corn production if there is an increase (decrease) in the price of corn, but with a smaller proportion. The value of output elasticity due to changes in input prices shows an inelastic value, meaning that the proportion of changes in supply due to changes in input prices is small. While the results of Hartoyo's (1994) study obtained the elasticity of maize supply to the price of maize alone at 0.911.The elasticity value of the elastic price offer indicates that the response of corn farmers in Indonesia to changes in prices is very large. Therefore, changes in the increase in corn prices will greatly determine the success of the corn development policy in Jambi. The value of elasticity in the supply of prices to variable output (seeds and fertilizers) is relatively small and inelastic. This indicates that the policy of input subsidies such as fertilizer and seed subsidies have less influence on farmers in using these inputs. Farmers will try to use seeds, fertilizer and labor according to their needs and according to the ability of their farming capital. Furthermore, from the four input variables it turns out that it has a significant effect of 1 and 5 percent on the output offered.

The impact of changes in output prices and input prices on output offers and input requests

The results of the estimation of the policy simulation to analyze the impact of government policies on output input and supply demand using the Fullgeniti and Perrin 1990 model can be seen in Table 3.

Scenario 1, if there is a policy of increasing the price of corn commodities by 15 percent, the number of corn commodities offered will increase by 21,463%. The increase in the price of corn commodities was also followed by an increase in the demand for seed inputs, urea fertilizer, SP36 fertilizer and labor which were relatively balanced with an increase in output of 14,483%, 17,126%, 16,562% and 13,642% respectively. Therefore, it is necessary to control the price of corn over the floor price and ceiling price.

Scenario 2, if there is a policy of reducing corn commodity prices by 15%, then the impact of the decline in the supply of corn commodities in Jambi is 14,483%. The decline in the price of corn commodities was also followed by a decrease in demand for seeds, urea fertilizer, SP36 fertilizer and labor which was relatively balanced with the decrease in output, which were respectively 14,483, 17,126, 16,562 and 14,642%. The decrease in input demand was due to a decrease in the price of corn commodities which caused a decrease in the motivation of farmers to increase production.

Scenario 3, if there is a policy of increasing seed prices by 15% resulting in a decrease in the supply of corn commodities by 5,772%. In addition, the increase in seed prices caused a decrease in demand for seeds by 7,638%. The increase in seed prices also led to a decrease in demand for urea fertilizer, SP36 fertilizer and labor by 5,334, 4,837 and 2,591% respectively.

Scenario 4, if there is a policy of increasing fertilizer prices 20% of the effect decreases by around 6,447% against the supply of corn commodities or smaller compared to the decrease in output due to the decline in the price of corn. These results indicate that farmers are not responsive to changes in the prices of urea and SP36 fertilizers. This is because farmers always try to buy fertilizer according to their capital capabilities. As a result of this policy, demand for seeds, urea fertilizer, SP36 fertilizer and labor decreased by 4,325, 6,067, 5,836 and -1,985% respectively.

Scenario 5, if there is a combination of policies in the form of an increase: corn commodity prices by 15%, fertilizer prices by 15% and seed prices by 20% lead to an increase in the supply of corn commodities in Jambi by 7,165%. As a result of these policies led to increased demand for seed inputs, urea fertilizer, SP36 fertilizer and labor respectively 2,256 4,256 5,182 and 9,764%.

Table 1. Estimation results of translog profit function parameters in Jambi province, 1990-2016

Variable		Estimation Parameters	P Value
Intercept		2.6524	0.0564
LNRS	Price of Seed (P. Benih)	-0.01235	0.0283
LNRUR	Price of Urea (P. Urea)	-0,3345	0.0083
LNRT	Price of TSP (P. TSP)	-0.1463	0.0134
LNRW	Labor Wages (WTK)	-0.6531	0.0065
LNZ1	Other costs (B. Lain)	-0,9567	0.0667
LNZ2	Harvested Area (L. Panen)	1,5634	0.0072
0.5 LNRS*LNRS	Interaction P. Benih with P. Benih	-0.0967	0.0008
0.5 LNRUR*LNRUR	Interaction P. Urea with P. Urea	-0.1872	0.0125
0.5 LNRT*LNRT	Interaction P. TSP. with P. TSP	-0.0175	0.1862
0.5 LNRW*LNRW	InteractionWTK with WTK	-0.0876	0.0435
0.5 LNZ1*LNZ1	Interaction B.Lain with B. Lain	-0.5872	0.1316
0.5 LNZ2*LNZ2	Interaction L. Panen with B. Panen	0.0283	0.7511
LNRS*LNRUR	Interaction P. Benih with P. Urea	0.0365	0.0477
LNRS*LNRT	Interaction P. Benih with P. TSP	-0.0082	0.3946
LNRS*LNRW	Interaction P. Benih with WTK	0.0334	0.0358
LNRS*LNZ1	Interaction P. Benih with B. Lain	-0.0421	0.0251
LNRS*LNZ2	InteractionP. Benihwith L. Panen	-0.0082	0.5261
LNRUR*LNRT	InteractionP. Urea withP. TSP	0.0256	0.8836
LNRUR*LNRW	InteractionP. Urea withWTK	0.0348	0.2243
LNRUR*LNZ1	InteractionP. Urea withB. Lain	-0.0451	0.0172
LNRUR*LNZ2	InteractionP. Urea withL. Panen	0.0056	0.6248
LNRT*LNRW	InteractionP. Urea withWTK	0.0224	0.0451
LNRT*LNZ1	InteractionP. TSP with B. Lain	-0.0235	0.0441
LNRT*LNZ2	InteractionP. TSP with L. Panen	-0.0074	0.4633
LNRW*LNZ1	InteractionP. WTK with B. Lain	-0.2112	0.1843
LNRW*LNZ2	InteractionWTK with L. Panen	0.0856	0.3841

Table 2. Alleged elasticity of supply output and input request scorn in Jambi province, 2016

Variable	Corn	Seed	Urea	TSP	Labor
Corn Prices	1.7891**	1.678*	1.7515	1.7922	1.5722**
	(0.0065)	(0.0123)	(0.0487)	(0.0598)	(0.0009)
Price Of Seeds	- 0.4574*	-0.7207*	-0.4138**	-0.3884	-0.2466*
	(0.0407)	(-0.0000)	(0.0064)	(0.0785)	(-0.0000)
Price of Urea	-0.3735	-0.4053**	-0.6774	-0.6253*	-0.2581
	(0.2215)	(0.0086)	(0.0868)	(0.0468)	(0.0955)
Price of TSP	-0.3784	-0.1639	-0.2784*	-0.3079	-0.1768**
	(0.0320)	(0.0745)	(0.0514)	(0.1086)	(0.0014)
Labor Wages	-1.3226**	-0.7619**	-0.7559	-0. 8444*	-1.2699**
	(0.0064)	(0.0009)	(0.0884)	(0.0589)	(0.0075)
AdditionalCosts	-2.1046**	-1.4172**	-1.5717**	-1.5717**	-1.1769
	(0.0009)	(0.0076)	(-0.0000)	(-0.0000)	(0.0102)
Harvest Area	1.7624**	1.8243**	1.7108**	1.1466*	1.4769
	(0.0090)	(-0.0000)	(0.0065)	(0.0303)	(0.0368)

Information; The number in parentheses is sig.

Table 3. Influence of changes in various factors on the supply and demand for input of corn commodities in jambi province, 2016

Change (%)		Change in Amount of Output Offer and Input Request(%)				
		Corn Commodity	Seed	Urea	SP_{36}	Labor
1.	Corn commodity prices (+15)	21.463	14.483	17.126	16.562	13.642
2.	Prices of corn commodities (-15)	-21.463	-14.483	-17.126	-16.562	-14.642
3.	Price of Seeds (+15)	-5.772	-7.638	-5.334	-4.837	-2.591
4.	Fertilizer Prices (+20)	-6.447	-4.325	-6.067	-5.836	-1,985
5.	Combination of 1,3,4	7.165	2.256	4.256	5.182	9.764
6.	Combination 2,3,4	-23.854	-25.584	-25.452	-26.185	20.322

Table 4. Impact of changes in output prices and input prices on commodity business benefits

No.	Policy Scenario	Change Of Business Profit (%)
1.	OutputPrices Are Up 15% And Input Prices Are Up 15% 6.77	6.77
2.	Output Prices Rose 20% And Input Prices Rose 10% 13.46	13.46
3.	Output Prices Fell 15% And Input Prices Rose 15% 2.34	2.34

Scenario 6, if the combination of corn commodity prices decreases by 15%, while seed input prices increase by 15% and fertilizer increases by 20%, causing a decrease in the supply of corn commodities by 23,854%. The combination of a decline in corn commodity prices and an increase in input prices also led to a decrease in demand for seed inputs, urea fertilizer, SP36, a relatively balanced labor force of 25,584, 25,452, 26,185 and 20,322% respectively.

The impact of changes in prices on business benefits of corn commodities: Reviewed from the effect of farmers' net income it turns out that the increase in corn prices will have a

large effect on increasing income. If an increase in the price of production inputs can still increase income but with a small proportion. The increase in corn prices along with an increase in the price of production inputs can still increase farmers' net income. Current production input prices do not seem to be the only determinant factor in the level of output supply. The increase in output prices with a greater proportion of rising input prices has a positive impact on the amount of output offered. The increase in the amount of output offered causes the farmers' income from the corn commodity business to increase. On the other hand, rising input prices cause production costs to increase.

The increase in the price of corn output with a greater proportion of rising input prices has a positive impact on the profitability of farmers. The impact of changes in output prices and input prices on the profitability of corn commodities is presented in Table 4. Table 4 shows that the increase in output prices is 15% and the input price of 15% causes the business profit of corn business to 6.77%. Meanwhile, if the output price rises 20% and the input price rises 10% causes the corn commodity business profit by 13.46%. Furthermore, if the output price drops (15%) and an increase in input price (15%) causes the gain in profit to increase by 2.34%. Based on the explanation above, it can be concluded that the acquisition of profits from corn farming will increase if the output price rises greater than the increase in input prices. The increase in output prices with a greater proportion of the increase in input prices causes the gain in commodity business profits to increase. This indicates that if the input subsidy is abolished by the government it will not have too much effect on reducing the supply of output and net income of farmers.

Conclusion

Based on the results of the analysis, the following conclusions can be drawn:

1. Offering output [corn] is not only influenced by its own price but also influenced by the price of input used. Output supply behavior is influenced by its own price and input prices. Corn supply elasticity to its own price is elastic.
2. Input demand is not only influenced by the price of the input itself and other inputs but is also influenced by the price of corn output produced. The behavior of demand for urea fertilizer input is influenced by its own price, SP36 fertilizer prices and corn prices. The elasticity of urea fertilizer demand for the price of the fertilizer itself is inelastic.

Recommendations

1. Efforts to encourage farmers to take risks by increasing the intensity of counseling and training on advanced aquaculture technology, and improving the managerial capacity of farmers, especially those related to risk management, thus helping farmers in production.
2. The supply elasticity of corn to its own price is elastic. Therefore, Corn prices can be used as a policy instrument to increase corn production. In addition, an increase in corn production can increase the number of workers requested, meaning that it can reduce farmer unemployment.
3. In irrigated, rainfed / tidaland tidal land, the diversity of plant species is quite high, so that it can be planted with both seasonal and plant crops a year. Therefore, further research will be better if done more widely by including various types of plants.

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