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Soybean production response: A study of Jambi's acreage response under policy program

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Soybean production response: A study of Jambi's acreage response under policy program

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Abstract. Research purpose was to analyse effect of agricultural business in soybean crop. Effect government policy program has be seen through high trend of soybean production in Jambi for three decade (1986-2018). Those policy programs include support price, also input subsidy programs. Differentiation on input acreage, yield, also output has been affected by input price like fertilizer price. Successfulness policy programs can be seen through crucial indicator among important coefficients of policy programs. In some research result, it can be found some policy implications. The first policy implication stated that price support policy is much credible also important for program improvement. Impact of this program of soybean is crucial to analyse response production. In analysing acreage response, method of measuring price expectation is used when variation of market phenomena was affected by price support. Then, results also found that if support price is low from riel price, truncation effect has no effect and price support program has low effect on acreage decisions. On other hand, if price support rate is high, truncation effect is getting higher, and it is much better impact to make acreage decisions. Price soybean elasticity was 0.091 also 0.105 for short-run acreage response and long run respectively. Moreover, it was acceptable on economic and statistical aspects.

1. Introduction

Agricultural production process is mostly identified by decision sustainability because time lags existed between input planning and output realization (Cochrane, 1995). In terms of soybean production, producers experience eager to choose type of soybean to be cultivated with existing of prices information and condition weather and insecticides in the regional place. Therefore, producers will be able to allocate input such as labour, seed, fertilizer. If input constraints exist rationally, producers eager to select its decision at every step, based on changing in this information (Edison, 2020).

Agricultural prices explain output or supply in terms of yield or production. The case of supply response is very crucial because it has impact on poverty, growth, development. Usually, this case is focus on many structural adjustment programs. Of course, scale of supply response is explainable on condition "a policy of fixing agriculture through lower farm prices or through overvalued exchange rates and industrial policies will generate resources for investment in other sectors of the economy or whether such policies will retard agricultural growth and create food and input bottlenecks which eventually bring down the rate of growth of the economy as the whole" (Edison, 2020).

Moreover, Nazli (2019) has explored the implicit and explicit variables of the agriculture sectors. For example, export crop sector like rice, corn, etc., has crucial meaning to tax agriculture through arranging produce prices under world prices. From 1980s and 1990s, proof has found that many trigger put to encourage growth have become an important to growth (World Bank, 2005). Governments have set monopoly and monopsony power by arranging or even decreasing private trade, and using parastatal agencies or heavy–handed marketing boards to assemble transport, and market commodities.

On the other hand, government support prices put indirectly by giving subsidies on commodities to consumer or on inputs to producers. Governments taxed producers directly and indirectly to keep food prices low and appropriate to urban interests (Oktaviani and Asmarantaka., 2010). Government intervention such as lowering producer's prices adversely affected on production, undermined the programs, and led government official prices in domestic to become international prices. Consequently, illegal or parallel markets emerged, and official monopolies could not be maintained.

Therefore, it is crucial to evaluate impact, understand policies that affect production of agricultural commodities, how effect of distortion takes, what policy improvement was created using possible adjustments (Xie and Wang, 2017). Moreover, appropriate response points is very crucial to know impact changes agricultural marketing and pricing policies. It considers crucial response to economic incentives for policy–maker (Tripath, 2008). Therefore, this paper attempts to comprehend which crops are responsive to price under agricultural market reform and to measure this responsiveness in order to assess whether reformation of agricultural markets, where it increases the effective prices paid to farmers, can be effective in stimulating production, especially in acreage response (Oktaviani and Asmarantaka, 2010).

If inputs are used, many farmers are not be able to control production process. Then, Output that was determined by some exogenous factors like factors of raining, drying, pesticides, diseases, and others, influence yield. Loss control causes difficult to evaluate supply ex-ante model, because it can be observed output as assessment supply ex-post model (Yenihebit et al. 2020).

From information above then it can be explored subject matter as: "Can supply response of farmers to input prices, output prices, government programs in farming, the price of fertilizer, pesticide price, area harvested and other exogenous variables be explained?" From issue and the problems above, research aims can be expressed: "Assessing the supply response of farmers to input prices, output prices, government programs in soybean farming, the price of fertilizer, pesticide price, area harvested, and other exogenous variables."

2. Review of Literature

Agricultural supply response represents the response of agricultural outputs to changes in agricultural prices or to agricultural incentives (Keeney and Hertel, 2008). Moreover, agricultural supply or output can be captured in any of the following: (a) sown acreage, (b) yield per acre, and (c) production amount. Certainly, issues of market level agricultural supply are central to development strategies, and there will be a prerequisite that the agricultural sector should provide a growing surplus of agricultural produce for increasing farm incomes and overall economic development of the nation. The contribution which agricultural sector can make in above areas will depend on the responsiveness of farmers to economic incentives and to price signals in particular (Edison, 2020). Theoretically, supply function of agricultural crops will depend on the price of commodity, the price of other competing commodities, the price of joint commodity, the price of inputs, the state of technology, the nature of the environment and the state of institutions (Mose and Kuyvenhoven , 2007; Edison, 2014).

Traditionally, lagged production model used to evaluate supply response in risk condition at aggregate level and also at producer (McSweeny et al. 1987). Meanwhile, problems expected returns and supply response in risky condition to formulate programming are user's problems. Good solution coming from constructing models can play crucial point to imply for policy concern and study. In integrating to select good construction, theoretical section on acreage response and implication on government policy are presented (Guyomard, 1996). Crucial approach applied on study risk model are acreage response in terms of yield in lagged also implication effectiveness of government programs. Whether, production function has been evaluated in a one or more product decision (Goodwin et al., 2018), models have not concerning risk factor. From this point of view, theoretically framework of product decision in risk using one variable approach are showed.

Agriculture supply model explains how quantity of yield used for sale differs as its price differs relatively to another prices (Edison, 2011). He explained explicitly among supply model. Supply equation explained yield that used on varying price, ceteris paribus, meanwhile, linkage supply response

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explain that occurs on supply if other are not stable (Carpentier et al., 2015). It can be explained a bundle theoretical formulation in the supply response model (Edison and Siata, 2017).

In order to explore Nerlove model, supply equation can be written as follows:

$$Y_t = c_o + c_1 X_t + c_2 S_t \quad \ldots \quad (1)$$

Where, Y_t is Actual quantity yield in time t, X_t is Actual price of soybean yield in time t, S_t = Supply components.

$$Y_t = c_o + c_1 X^*_t + c_2 S^*_t \ldots \quad (2)$$

Where, Y_t is yield in year t, X^*_t is Optimum price in year t, S^*_t is Supplies component in year t. Optimum price is unobservable and is used as normal price, for example, condition in which future price is optimum to be unstable. Expression may be stated as:

$$X^* - X^*_{t-1} = \beta (X_{t-1} - X^*_{t-1}), \quad 0 \le \beta \le 1 \ldots \quad (3)$$

It is assumed that optimum price is actual price. i.e. X = X*

It got following formulation by using price of X* in equation (2) then put in equation (1), rearrange it as.

$$Y_t = d_o + d_1 X_{t-1} + d_2 Y_{t-1} + d_3 S_{t-1} + d_4 S_{t-1} \ldots \quad (4)$$

Function (4) is used to evaluate economic aspect.

In order predict elasticity, it used a formula as $\partial Y/\partial X$. X/Y. And to evaluate short run, also long run, there can be expressed in short-run of $\partial Y_t/X_{t-1}$, in long-run of $d_1/1-d_2$ (Gujarati and Porter, 2009).

3. Methodology

Study was conducted in Jambi, since Jambi becomes producers of soybean Indonesia. And study was carried out in 2019. To Implement of study, it used survey methods. Research used time series data in year 1986-2018. Data among 1986-2018 is used to explain economic crisis period and varies with level of economic crisis high, medium and small. And also it capture two government era such as new era and reformation era. The data sets used were annual observations covering the period 1986–2018 from "Jambi Agricultural Statistics, 1997 and 2019". General consumer price index was used from "Various Issues of Monthly Selected Economics Indicators", by Central Statistical Organization, Ministry of National Planning and Economic Development.

3.1 Mathematical form of the Model

Research on acreage response consider many alternative to choose good model. The following models were got among many mathematical forms on basis of econometric, economic aspects such dynamic response (Colin and Townsend, 2011).

Acreage Response Model

Research on supply response focus on measurement acreage response, because production is varied. This condition is caused that production response can be decomposed of production or supply response. When input land and new seeds develop in any significant extent level, yield response may be considerable. On the other hand, since riel production levels reflect influence of uncontrollable component like weather, disease and infrastructure, supply response on yield levels is problematic.

$$A_t = f(X_{t-1}, A_{t-1}, D_t, e_t) \ldots$$

(5) where, Y_t = yield in year t. A_t = acreage in year t. X_{t-1} = price in year t-1. Y_{t-1} = yield in year t-1. A_{t-1} = acreage in year t-1. Dt = dummy variable (new era of 1986 - 1997 = 0, reformation era of 1998 – 2011 = 1), e_t is error term.

Model generally used on supply response analysis on time series data and it will be adaptive expectations (distributed lag) model. In this research, the Nerlovian lagged adjustment model was used. Acreage response means dynamic acreage with each unit changing in variables affecting on during period of study (Yu et al. 2012).

The Nerlove partial adjustment model

This research has mostly focused on evaluating price movement on acreage supply. In most cases, it called Nerlove model (Nerlove 1958) has been explored. Method involves estimation of partial adjustment model of agricultural production. Supply function of partial adjustment model has general model (Kibet et al. 2019);

$$\text{Ln } A_t^* = \beta_1 + \beta_2 \ln X_{t-1} \ldots$$

(6)

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Where; A_t* denotes desired acreage at time t, and X_{t-1} denotes the output price at time t–1.

$\ln A_t - \ln A_{t-1} = \lambda(\ln A_t^* - \ln A_{t-1})$ …………………………………………..

(7)

Where; A_t is actual acreage, and

λ is partial adjustment coefficient.

According to equation (4), adjustment costs imply that the actual change in acreage between two periods is only a fraction of the change required to achieve the optimal acreage level A_t*. Substituting, (6) into (5) and rearranging gives;

Ln $A_t = \beta_1\lambda + \beta_2\lambda \ln X_{t-1} + (1-\lambda)A_{t-1} + \mu_t$ …………………………………………………

(8)

From this model, the following can be investigated: (a) the short–run reaction of A_t to a unit change in X_{t-1} is $\beta_2\lambda$; (b) the long–run reaction is given by β_2; and (c) an estimate of β_2 can be obtained by dividing the estimate of $\beta_2\lambda$ by one minus the estimate of (1–λ), i.e. $\beta_2 = \beta_2\lambda/[1-(1-\lambda)]$. Symbols and definitions of the variables used:

A_t =acreage planted at time t

X_{t-1} =prices deflated by general consumer price index at time t–1

A_{t-1} =acreage planted at time t–1

Short run and long run elasticity :

The elasticity of variables show that the influence of unit change in variable on acreage decisions of crops. In the present study, variable elasticity were estimated for short run as well as for long run period.

Moreover, the short run and long run elasticity have been estimated as :

Short run elasticity (SRE) = Regression coefficient of price × (Mean of price / Mean of area) and Long run elasticity (LRE) = $b_1/1-b_2$.

4. Results and Discussion

The research objective was to analyse supply response of farmers' decision on government policy programs. Expected Utility Profit model is used to evaluate hypothetic parameters. This model is constrained to variables with respect to government policy programs to investigate optimal decision.

(A) Production and Acreage Response

Soybean is crucial crop not only on improvement, development on agriculture but also on utility capacity, improvement industrial sector that based on input on agriculture. Based on its movement, this was likely that it has good relationship soybean to industry and others, which can create labour sector, value added in economy sectors (Yu et al. 2010).

Time series used on soybean present research is year of 1986 - 2018 and secondary data was collected from many analyses (Various Sources Indonesian Economic Survey). Production and acreage response was analysed in main focus for research. The results were found and seen in Table 1, and 2.

Table.1. Structural coefficient for soybean production response

Variable	Co-efficient	Standard Error	t-Ratio	Significance
Constant	8.37	0.982		
X_{t-1}	0.258	0.098	2.633	**
A_{t-1}	0.519	0.129	4.023	***
D_t	- 0.302	0.126	2.397	**
R2 (Adjusted)	0.9246			

*** = Significant at 1 percent level of Significance.

** = Significant at 5 percent level of Significance

Research found that coefficient of determination production response equation showed 92.46% variation in production of soybean. It can be said that explanatory component existed in model was 92.46%. Estimated value lagged price had positive sign. Its value was significant that meant each unit price increases year before, yield increased about 0.258 unit. Value and coefficient estimation is likely equal to expectations. Estimation of lagged yield had positive sign of 0.519 and significant at 1 percentage confidence level. It had meaning that lagged production soybean had significant effect on soybean yield. Value and magnitude of coefficient was likely equal to expectations. Dummy variable represented the new order era in 1968-1998, coefficient was negative, that was expected with value of 0.302 and significant. This meant that effect of new order era on production was un-significant be due to non-availability of inputs at crucial stages in production.

Table.2. Structural coefficient, for soybean acreage response

Variable	**Co-efficient**	**Standard** Error	**t-Ratio**	**Significance**
Constant	13.108	1.381		
X_{t-1}	0.091	0.041	2.220	**
A_{t-1}	0.138	0.141	0,979	
D_t	- 0.116	0.042	2,762	**
R2 (Adjusted)	0.9184			

** = Significant at 5 percent level of Significance

Coefficient determination has value 0.9184, which has meaning that about 92% percentage problem in acreage response was determined by other component in model. It has positive sign lagged price of 0.091. Coefficient estimation was significant, it showed lagged price gave effect significantly in model. Lagged acreage response gave positive sign, that it was expected, with value of 0.138 also non-significant. It meant scope of soybean expansion just limited. Dummy component expressed new era on 1968-1998, coefficient estimation was negative with value of 0.116 and significant. Therefore, it showed agricultural condition caused impact on acreage un-significantly. It was caused inappropriate irrigation condition and other. It was also not available good inputs and others.

(B) Impact of Policy Programme on Soybean Production

To evaluate movement impact on policy programme, it is needed to analyse effect policy programme such as fertilizer, pesticide used in soybean production because those programme had positive impact in improving production also support in getting better production which needs appropriate input fertilizer and input pesticide used each hectare in year before, lagged time trend, also presented linear on formula as:

$$Y_t = \beta 0 + \beta 1 \text{ᵼ}_{t-1} + \beta 2 \Phi_{t-1} + \beta 3 T + \epsilon_t \quad \text{.........} \qquad (9)$$

where : Y_t = soybean crop yield in year t; ᵼ_{t-1} = fertilizer used per hectare in year t-1; Φ_{t-1} = pesticide used per hectare in year t-1; T = time trend variable; $\beta 0$ = intercept; $\beta 1 - \beta 3$ = parameters; ϵ_t = error term

The OLS method was used to estimate the soybean yield parameters. The estimated equation was as follows:

$$\delta(At) = 512{,}8 + 0{,}068\ T + 0.328\ At\text{-}1 + 1.408\ \delta\ (At\text{-}1) \quad \text{.........} \qquad (10)$$

(0,216) (0,178) (0,032) (42,4)

D.W. = 0,5216 R^2 = 0,7925

Equation (9) showed that input fertilizer and input pesticide had positive effect in soybean production because it has positive parameter and significance. It indicated that more input fertilizer and input pesticide used showed more soybean production. Parameter trend variable was more than zero. It indicated that technological movement had significant impact in soybean yield.

Program on subsidy input supports producers in applying better input fertilizer and input pesticide that has impact on better output. Then, applying more fertilizer, it can increase total output of soybean. So that, program of input subsidy will give good impact for producers to improve soybean yield, and move acreage curve to the right. Therefore, program of price subsidy has effect on economic effect through moving curve of supply to the right.

(C) Elasticities

From price changing point of view, research found production and acreage elasticity. Elasticity estimation on short-run and long run on production and acreage response under soybean were presented in the following table.

Table 3. Price Elasticities for Production and Acreage

	Production Response	Acreage Response
Short Run	0.258	0.091
Long Run	0.536	0.105

Price elasticity on soybean production stated when soybean price increased 1 percentage during period of study, soybean production grew up about 0.258 percentage in short run and 0.536 percentage in long run respectively. In terms acreage response, when soybean price increased by 1 percentage during period of study, acreage increased about 0.091 percentage in short run and 0.105 percentage in long run respectively.

Results of acreage response function for soybean by ordinary least square method is shown in table (2). Serial correlation was tested by Durbin–Watson statistics. Durbin–Watson statistics 0,516 and were acceptable for the problems of serial correlations. The values of the coefficient of determination, R^2, having 92%, for soybean indicated that the model is goodness of fit for data generating process.

The coefficients of lagged acreage were highly significant in soybean acreage estimates. According to the theory, these coefficients being positive and less than one implied that long–run elasticities exceed short–run elasticities, i.e., a period of more than a year was required for soybean farmers to be able to fully adjust their planting decisions in response to exogenous shocks. The extension of acreage of soybean will be limited because large amount of marketable surplus over domestic demand will cause a sudden decrease of price resulting hesitation to farmers for area expansion. Acreage of exportable soybean can be expanded as much as possible for availability of land and capital because production of marketable surplus. Estimated coefficients of partial adjustment and short–run and long–run elasticities are shown in table (3).

The partial adjustment coefficients were 0.91 for soybean. The coefficients indicated that economic adjustment was quite slow in response to acreage of soybean. The short–run elasticities were low, because main inputs, such as land, labour and capital were fixed. In other words, 10 % increase in the of price soybean would bring the increase in acreage planted only 9.1%, for soybean. Although short–run elasticities were less than (1), which were considered inelastic theoretically, long–run elasticities were larger than short-run, being considered inelastic in acreage response. In long–run, 10% increase in soybean price would bring the increase in acreage planted 10.3%, for soybean. So, it could be said that prices were incentives for farmers to plant more areas especially in exportable soybean; and agricultural price and market reform with domestic and export liberalization were important factors for positive response to acreage decision of farmers.

5. Conclusion

From discussion above, it can be concluded that there found some results. Simulating model of acreage at combination of price support rate was used to analyse supply response decisions. Furthermore, risk component become key role to explain model of acreage. Model simulation was applied to analyse government program effectiveness. Therefore, risk component was used to learn the effect on acreage response. First of all, lagged production function was applied to estimate empirical expectation variables. Those parameters estimation informed that risk variables have played crucial role for producers to make decisions. It also found that producers are risk averse. So that, risk management has to be considered , and also dynamic considerations. In conclusion, risk component played crucial role in evaluate successfulness of policy like government farm program, such as deleting risk component will improve acreage response which it has meaning acreage curve will change to the right. Price soybean elasticity was 0.091 also 0.105 for short-run acreage response and long run respectively. Moreover, it was acceptable on economic and statistical aspects.

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