# SUPPLY RESPONSE OF THE SOYBEAN IN INDONESIA

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**Submission date:** 28-Aug-2018 07:29AM (UTC+0700)
**Submission ID:** 993935628
**File name:** SUPPLY_RESPONSE__Wiludjeng_Roessali_Undip_1.pdf (573.96K)
**Word count:** 3253
**Character count:** 17565

# SUPPLY RESPONSE OF THE SOYBEAN IN INDONESIA*)

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## ABSTRACT

Soybean is one of the high-value food commodities. Domestic soybean production has been unable to meet the needs of the community so that the import options to meet the needs. Increased demand is growing bigger every year, causing dependence on imported soybean. This study aimed to assess factors that influence the supply of soybeans during 1993-2015 in Indonesia. A hypothesis test is done with a partial adjustment model and the Durbin-Watson statistic is used to test for the problem of autocorrelation in the data. The results showed that the rate of land growth and soybean production decreased on average per year by 2.81 and 1.6 percent, respectively, while productivity grew by 1.4 percent. The short-term and long-term supply elasticity was influenced by the area of soybean harvest, the area of corn harvest, the productivity and the price of local soybeans, while the price of imported soybean did not show any significant effect. The coefficient of production adjustment suggests the study suggests to considering this elasticity for agricultural planning and policy assessment.

Keywords: supply, soybean, partial adjustment, cultivated area, price,

## INTRODUCTION

Soybean is an important food for the people of Indonesia and has been included in the national food program. Based on the National Medium-Term Development Plan (RPJMN) 2010-2014, the target of food production growth per year is the priority of food security is set at 3.2% for rice, 10.02% for corn, 20.05% for Soybeans, 12.25% for sugar, and 7.3% for beef. The total production of rice, soybeans, and maize shows an increase from 2006 and is predicted to increase in the years to come. Supadi (2009) stated that Indonesia's growth of dependence on soybean imports continued to increase from 1978. In 2006, it reached a dependency rate of 54.66% and after 2006 more than 60%. Therefore, increasing productivity is one way to improve the competitiveness of this commodity. The soybean-based industries that have grown are industrial tempeh, tauco, soy sauce, tofu, and milk. However, Indonesia's soybean production is only able to meet about 35 percent of the needs, and as many as 55 percents of which are still imported.

*)Presented at The 6th Indonesian Regional Science Association (IRSA) International Institute: Maritime Infrastructure and Regional Development in Manado, North Sulawesi on 17-18 July 2017.

The long-term soybean development program is to increase domestic production to reduce imports to meet the needs of today's growing industries (Fahma, 2007).

Efforts to increase soybean production, among others through the acceleration of the implementation of intensification quality improvement (PMI) and integrated crop management (PTT), encourage the optimization of land use, planting area expansion, breeder development, and quality seeds between fields (Department of Agriculture Food and Horticulture Plant, 2012). Nevertheless, the rate of demand is still much higher than the increase in production. Population growth rate from 2000-2010 amounted to 1.49% (BPS, 2011), and in the period 2011-2015 at 1.24% (BPS, 2016).

Demand for soybean continues to rise due to high demand, soybean demand growth rate of 2011-2015 increased by 1.79% on average. On the other hand, Indonesia's soybean production tends to decline so that the government must import to meet the needs. Rising demand for soybeans is caused by an increase in population, economic growth, increased purchasing power, and changes in taste (Zakiah, 2011). More than 90% of soybean in Indonesia is used as foodstuff, especially processed food, which is about 88% for tofu and tempeh and 10% for other processed foods and about 2% for seeds (Sudaryanto 1996, Swastika et al., 2005).

Soy products as processed foods have potential and play a role in the development of small and medium industries. The development of food industry made from soybeans also opens job opportunities, ranging from cultivation, processing, transportation, market to the processing industry. Sudaryanto (2005) stated that the development of soybean in Indonesia is quite good because agriculture is still supported by protection policy. However, Zakaria et al (2010) shows that soybean farming is limited by the availability of high-quality and high-risk seeds and there is no reasonable price guarantee.

Various analytical tools are often used to find out the commodity supply response, one of which is the "Partial Adjustment Model" or "partial adjustment model". This paper focuses more on efforts to understand the use of the partial adjustment model approach in discussing the response to soybean supply in Indonesia.

## RESEARCH METHODS

The data used is a series of soybean data from within the period of 22 years, from 1993 until 2015. Data obtained from BPS, Deptan and FAO which includes data of land area, production, productivity, export data, and the development of world soybean prices.

To estimate the bidding function using the Partial Adjustment Model (PAM) or Partial Adjustment Model (MPP) also known as the Stock Adjustment Model. This model is chosen because it has advantages: (1) the error of the partial adjustment model is not directly related to the previous error because it is assumed that the error (δet) is not self-correlated, (2) the partial adjustment coefficient of the Yt-1 independent variable has a clear economic meaning and (3) using the partial adjustment coefficient value, the elasticity of the long-term supply response can be calculated. The Koyck model developed by Mark Nerlove in 1958, is a simple method used in estimating dependent relationships with independent variables that in their equation accommodate different lag variables (Gujarati, 2004). The assumption of this model that the unexpected variable (Y) expected in period t (written Yt*) cannot be observed directly. The variable Yt* will depend on the actual free (Xi) variable (Pindyck & Rubinfeld, 2001). The mathematical formulation is written as follows:

$$Y_t^* = \alpha_0 + \alpha_1 x_{it} + \mu_t \quad \text{..... (1)}$$

Where:
Yt * = unexpected free variable.
Xit = the free variable (actual) expected to affect Yt*
$\mu_t$ = error
Since the expected value of Y can not be observed directly, the postulate of Nerlove (1958) assumes a hypothesis:

$$\frac{Y_t}{Y_{t-1}} = \left[\frac{Y_t^*}{Y_{t-1}}\right]^{\delta} + v_t \quad \text{..... (2)}$$

In linear form is written:

$$Y_t - Y_{t-1} = \delta\,(Y_t^* - Y_{t-1}) + v_t \quad \text{..... (3)}$$

In this case :

Yt - Yt-1 = change of actual Y value

Yt* - Yt-1 = change of expected Y value

δ = adjustment coefficient $0 < \delta \leq 1$

If the value is δ = 1, then the actual value of Y is equal to the expected Y value. That means the actual value of Y adjusts to the expected value of Y immediately in the same period. If value δ =

0, it means the actual value of Y at time t is the same as observed in the previous year (no change). Equation (3) is specifically known that the change of Y in period t will be responded only partially by the difference (difference) of expected Y value with the previous value Y (Yt * -Yt-1). The degree of response is indicated by the adjusment coefficient (adjustment) δ (Pindyck & Rubinfeld, 1976). The adjustment mechanism in equation (3) takes place as follows:

$$Y_t = \delta\,(Y_t^* - Y_{t-1}) + Y_{t-1} + v_t$$
$$= \delta\, Y_t^* - \delta Y_{t-1} + Y_{t-1} + v_t$$
$$= \delta\, Y_t^* + (1-\delta)Y_{t-1} + v_t \quad \text{..... (4)}$$

Substitution (1) to (4), produces:

$$Y_t = \delta(\alpha_0 + \alpha_t X_{it} + \mu_i) + (1-\delta)Y_{t-1}) + v_t$$
$$= \delta\alpha_0 + \delta\alpha_t X_{it} + \delta\mu_i + (1-\delta)Y_{t-1}) + v_t$$
$$= \delta\alpha_0 + \delta\alpha_t X_{it} + (1-\delta)Y_{t-1}) + (\delta\mu_i + v_t) \quad \text{..... (5)}$$

Solution of equation (5) can be done through regression technique, logarithm or linearly. In this case δ, α 0, α 1 and (1- δ) are expected parameters. When the parameters α0 and α1 are known then (1- δ) can be calculated. The response rate (elasticity) shown by the Yt elasticity coefficient to Xit can be calculated from the linear equation:

In the short term: $E_{sr} = \delta\alpha_1 . \frac{X_{it}}{Y_t}$ .....(6)

In the long term: $E_{sr} = \frac{\delta_{\alpha_1}\frac{X_{it}}{Y_t}}{(1-\delta)}$ ..... (7)

From Logarithmic Equations:

In the short term: $E_{sr} = \delta\alpha_i$ ..... (8)

In the long term: $E_{lr} = \frac{\delta\alpha_i}{(1-\delta)}$ ..... (9)

## RESULTS AND DISCUSSION

### Development of Soybean Production

The development of soybean production in Indonesia shows decrease from year to year. In the seven provinces, the highest soybean contributor in Indonesia from 1993 to 2015 decreased on average by 2.57 percent (Table 1). Lampung experienced the highest decrease in production, which was 10.96 percent on average, followed by Central Java and East Java each

dropping an average of 2.51 and 2.1 percent. However, the provinces of East Java and Central Java remain the highest contributor of soybean in Indonesia (BPS, 1995-2015).

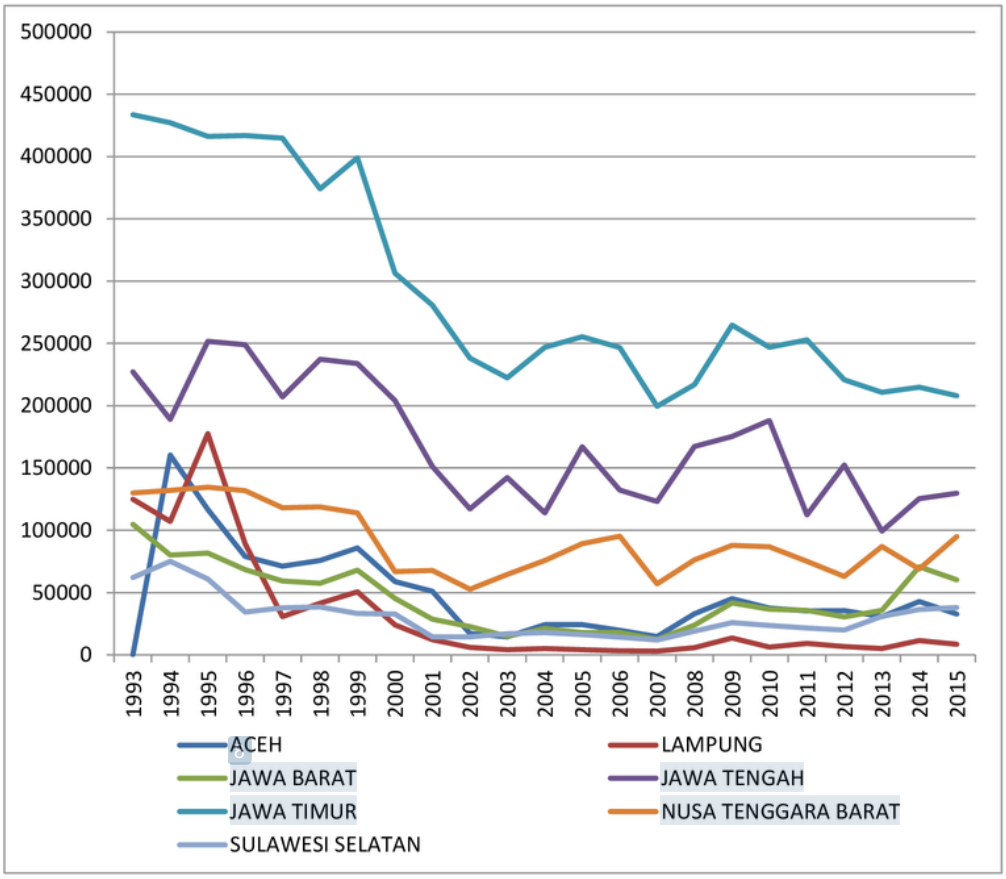



Figure 1. The Development of Soybean Production in Seven Provinces of the Highest Soybean Producers in Indonesia in 1993-2015 (tonnes)

During the period of 1970-1992, national soybean production continued to grow convincingly. It peaked in 1992 with 1.87 million tons of production, but since 1992, soybean production has declined sharply along with the decline of harvest area (Sudaryanto and Swastika, 2005). The high growth is largely due to the growth of the harvest area, and partly due to technological developments.

Table 1. The Rate of Soybean Production Development in Indonesia 1993-2015 (tonnes)

| Year | PROVINCE | | | | | | | INDONESIA |
|---|---|---|---|---|---|---|---|---|
| | ACEH | LAMPUNG | JABAR | JATENG | JATIM | NTB | SULSEL | |
| 1993 | 190220 | 126204 | 125559 | 227134 | 549713 | 132752 | 77146 | 1707126 |
| 1994 | 182205 | 110380 | 94908 | 188903 | 493632 | 130284 | 90115 | 1564179 |
| 1995 | 144935 | 183566 | 95670 | 251597 | 487190 | 136773 | 77245 | 1679092 |
| 1996 | 100004 | 92730 | 81296 | 248946 | 509096 | 135156 | 47695 | 1515937 |
| 1997 | 90517 | 31914 | 75239 | 207019 | 511531 | 122345 | 50111 | 1356108 |
| 1998 | 92915 | 43008 | 70976 | 237156 | 457272 | 124273 | 49516 | 1304950 |
| 1999 | 106480 | 53848 | 85988 | 233725 | 485878 | 117471 | 43949 | 1382848 |
| 2000 | 71576 | 22457 | 55075 | 204064 | 385212 | 70771 | 42710 | 1017634 |
| 2001 | 63127 | 12391 | 34603 | 151178 | 349188 | 72111 | 18605 | 826932 |
| 2002 | 21522 | 6032 | 29790 | 117068 | 300184 | 59994 | 19324 | 673056 |
| 2003 | 18697 | 4360 | 19822 | 142315 | 287205 | 76333 | 24140 | 671600 |
| 2004 | 31170 | 5388 | 29090 | 113852 | 318929 | 91495 | 26873 | 723483 |
| 2005 | 31067 | 4699 | 23845 | 167107 | 335106 | 106682 | 27187 | 808353 |
| 2006 | 25495 | 3594 | 24495 | 132261 | 320205 | 10864 | 22242 | 747611 |
| 2007 | 19025 | 3396 | 17438 | 123209 | 252027 | 68419 | 18972 | 592534 |
| 2008 | 43885 | 6678 | 32921 | 167345 | 277281 | 95106 | 29125 | 775710 |
| 2009 | 63538 | 16153 | 60257 | 175156 | 355260 | 95846 | 41279 | 974512 |
| 2010 | 53347 | 7325 | 55823 | 187992 | 339491 | 93122 | 35711 | 907031 |
| 2011 | 50006 | 10984 | 56166 | 112273 | 366999 | 88099 | 33716 | 851286 |
| 2012 | 51439 | 7993 | 47426 | 152416 | 361986 | 74 56 | 29938 | 843153 |
| 2013 | 45027 | 6156 | 51172 | 99318 | 329461 | 91065 | 45693 | 779992 |
| 2014 | 63352 | 13777 | 115261 | 125467 | 355464 | 97172 | 54723 | 954997 |
| 2015 | 47910 | 9815 | 98938 | 129794 | 344998 | 125036 | 67192 | 963183 |
| r | -6.08 | -10.96 | -1.08 | -2.51 | -2.10 | -0.27 | -0.63 | -2.57 |
| 1993-1995 | 15968 | 3268 | 32979 | 43264 | 114999 | 41679 | 22397 | 321060 |
| 1996-2000 | 25445 | 5370 | 49435 | 59704 | 163092 | 52777 | 28862 | 447848 |
| 2001-2005 | 17863 | 3688 | 36270 | 46552 | 124617 | 43898 | 23690 | 346418 |
| 2006-2010 | 11854 | 2463 | 23737 | 29904 | 80541 | 27671 | 14990 | 223065 |
| 2011-2015 | 14225 | 2956 | 28484 | 35884 | 96649 | 33205 | 17988 | 267677 |

Source: BPS (1995-2016)

Information : JABAR = West Java : JATENG = Central Java ; JATIM = East Java;
NTB = West Nusatenggara; SULSEL = South Sulawesi

The significant growth of harvested area is the result of various programs to increase the production towards soybean self-sufficiency. The programs include: Soybean "Insus", Soybean, and Soybean "Opsus", including the development of soybean in marginal land (Sihombing 1995, Manwan and Sumarno 1996). The growth of harvested area increased by an average of 0.27 percent per year in the 1993-1995 period, but after that period the development of harvested area

tended to fall sharply, especially in 2000, and continued to decline until 2005 (Table 2). This sharp drop in production has left Indonesia highly dependent on soybean imports.

Table 2. Development of Production, Harvested Area and Productivity of Soybean in Indonesia Year 1993-2015

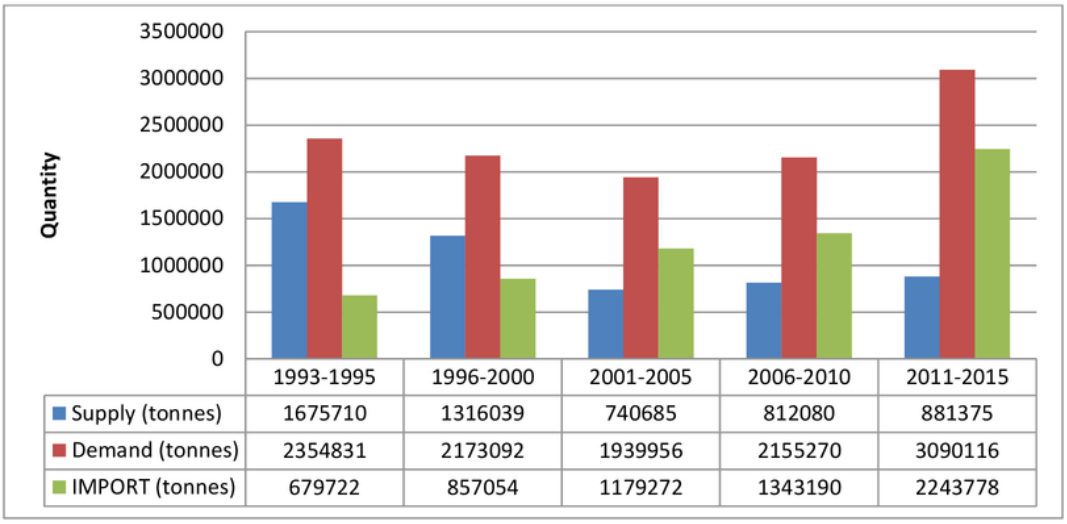
| Year | Production (tonnes) | Harvest Area (ha) | Productivity (hg/ha) |
|---|---|---|---|
| 1993 | 1707126 | 1468316 | 11.63 |
| 1994 | 1564179 | 1406038 | 11.12 |
| 1995 | 1679092 | 1476284 | 11.37 |
| 1996 | 1515937 | 1277736 | 11.86 |
| 1997 | 1356108 | 1118140 | 12.13 |
| 1998 | 1304950 | 1094262 | 11.93 |
| 1999 | 1382848 | 1151079 | 12.01 |
| 2000 | 1017634 | 824484 | 12.34 |
| 2001 | 826932 | 678848 | 12.18 |
| 2002 | 673056 | 544522 | 12.36 |
| 2003 | 671600 | 526796 | 12.75 |
| 2004 | 723483 | 565155 | 12.8 |
| 2005 | 808353 | 621541 | 13.01 |
| 2006 | 747611 | 580534 | 12.88 |
| 2007 | 592534 | 459116 | 12.91 |
| 2008 | 775710 | 590956 | 13.13 |
| 2009 | 974512 | 722791 | 13.48 |
| 2010 | 907031 | 660823 | 13.73 |
| 2011 | 851286 | 622254 | 13.68 |
| 2012 | 843153 | 567624 | 14.85 |
| 2013 | 779992 | 550793 | 14.16 |
| 2014 | 954997 | 615685 | 15.51 |
| 2015 | 963183 | 613885 | 15.68 |
| Growth | | | |
| 1993-1995 | -0.82 | 0.27 | -1.12 |
| 1996-2000 | -9.48 | -10.37 | 1.00 |
| 2001-2005 | -0.57 | -2.18 | 1.66 |
| 2006-2010 | 4.95 | 3.29 | 1.61 |
| 2011-2015 | 3.14 | -0.34 | 3.47 |

Source : BPS (1995-2016)

Table 2 shows that in the period of 1996-2000 there was a decrease of harvested area up to 10.37%. In the period 2006-2010 the area of harvest increased by 3.29% and productivity always increased, soybean production increased almost 5%. The period of 2011-2015 harvested area decreased 0.34% and production also decreased compared to previous period.

**Growth of Consumption**

Since 1992, domestic soybean production has continued to decline, domestic soybean demand is supplied from imports, so that the soy available for domestic consumption is declining. Data show during 1995-2011 period soybean imports increased average per year by 4.37% or about 48% of domestic soybean demand was met from import (Litbangdeptan, 2011). On the other hand, the population continues to increase, demand for soy-based industries is increasing. Soy consumption in the period 1991-1995 reached an average of 12.54 kg per cap / year. After the period 1996-2000 to 2011-2015 decreased from 10.86 kg to 9.21 kg per / cap / year, dropped by a rate of -1.5%. While supply of soybean in the same period decreased by -3.97% (Figure 2).




| | 1993-1995 | 1996-2000 | 2001-2005 | 2006-2010 | 2011-2015 |
|---|---|---|---|---|---|
| Supply (tonnes) | 1675710 | 1316039 | 740685 | 812080 | 881375 |
| Demand (tonnes) | 2354831 | 2173092 | 1939956 | 2155270 | 3090116 |
| IMPORT (tonnes) | 679722 | 857054 | 1179272 | 1343190 | 2243778 |

Figure 2. Supply, Demand, Consumption, Soybean Import 1993-2015
Source: Litbangdeptan (2011), BPS (2016), FAO (2013)

Figure 2, it can be seen that the amount of soybean consumption (demand) in Indonesia is higher than the amount of supply. An increase in the average population of 1.3% so that in 2015 reached 255 million people and the average consumption of soybean per capita of 10 kg / year so required soybean for food needs of at least 2 million tons per year. The need is used for tempeh and tofu production of about 88%, 10% is used for other processed foods such as starch and starch industries and the remaining 2 percent for seed (Facino, 2012).

Based on Figure 2, the position of soybean production in Indonesia is always below the demand graph during the 1993 - 2015 quadrant. In general, the picture shows significant fluctuations. Data for the period 2011-2015 indicates a considerable disparity between the quantity of production and consumption in Indonesia, it appears that the production (supply) is only about 881.375 tons while demand reaches 3,090,116 tonnes

The existence of a large gap between demand and supply of soybean, the government's solution to meet the demand for soybean is the policy of soybean import. Although soybean production in Indonesia shows an increase in the period 2001-2015, but this can not offset the rate of increase in consumption (demand) of soybeans. According to Facino (2012), the increasing trend of soybean consumption in recent years is indicated by the increase of population which directly affected the increase of soybean consumption, especially the indirect consumption (processed) in this case tofu and tempeh which is staple food based on soybean. 50% of soybean demand to meet the needs of members of the Indonesian Tempeh and Tofu Producers Cooperative (KOPTI). In addition to importing soybeans, the government is also continuing efforts to increase domestic soybean production to reduce dependence on imported soybeans, such as PAJALE Program (rice, corn, soybeans).

**Development of Import**

Domestic import demand, is the excess consumer demand for shortages of producer offerings. Currently there are only four soybean importers namely Carlgill Indonesia, Teluk Intan, Liong Seng dang Gunung Sewu which form the market structure of soybean. It is alleged that this market structure of soybean imports as a regulator of soybean prices in Indonesia Soybean Indonesia. Indonesia still has to continue importing an average of 50% of national soybean demand. Domestic production is still relatively low and has a declining trend. This causes the dependence of imported soybean to continue and tend to increase. Based on Figure 1, it can be seen that in 1993 soybean import tends to increase sharply. In the period of 2001-2005, soybean imports reached 1.34 million tons. Overall during that period the national soybean import trend showed an increase of 37.6% from the previous period, and increased to 2.24 million tons in the period 2011-2015.

**Factors affecting Soybean Supply in Indonesia**

The results of the analysis of factors affecting soybean supply in Indonesia resulted in estimates as shown in Table 3.

Tabel 3. Factors Influence Soybean Supply

| Variable | Notation | Coefficient | | Probability | | Sig | |
|---|---|---|---|---|---|---|---|
| | | SR | LR | SR | LR | SR | LR |
| Constant | C | -856.26 | -877.921 | 0.0000 | 0.0000 | ** | ** |
| Land of soybean harvested | LSH | 1.1058 | 1.1563 | 0.0000 | 0.0000 | ** | ** |
| Land of corn harvested | LCH | 0.00005 | 0.00003 | 0.0046 | 0.0281 | ** | * |
| Productivity of soybean | PVS | 623.05 | 678.324 | 0.0000 | 0.0000 | ** | ** |
| Price of soybean | PS | -0.00023 | -0.00018 | 0.0249 | 0.0811 | * | ns |
| Price of soybean import | PSI | 0.00768 | 0.002685 | 0.4695 | 0.8059 | ns | ns |
| Production adjustment | PP | 0.03297 | - | 0.1844 | - | ns | |

SR = short-run, LR = Long-run
*) significant $\alpha = 0.05$
**) significant $\alpha = 0.01$
ns = non significant

## CONCLUSION

The increase of soybean production from both quantity and quality to cover the demand of soybean must be continuously pursued by the government, both extensification and intensification especially through:

1. Increase the area of planting soybean
2. Socialization of technology to increase productivity
3. Increasing the interest of farmers to plant soybean through price controls that benefit farmers.

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