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Paddy Supply Response in Sleman Regency

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ABSTRACT
This research aims to identify and analyze the variables that affect the paddy supply response in Sleman Regency and determine the level of elasticity of paddy supply in Sleman Regency. This research used a descriptive method with Nerlove adjustment. The research location was chosen purposively in Sleman Regency and used time-series data for 30 years from 1990-2019. This research used harvested area and paddy productivity approaches to determine the results. Based on the paddy harvested area approach, it can be explained by the paddy price in year t-1, paddy production in year t-1, paddy harvested area in year t-1, substituted commodities (maize) price in year t-1, and urea fertilizer price in year t while in the paddy productivity approach in year t it can be explained by paddy productivity in year t-2. The elasticity of paddy price in year t-1, paddy production in year t-1, substitute commodities (maize) price in year t-1, and the urea fertilizer price in year t is inelastic in the short and long term and paddy harvested area in year t-1 is inelastic in the short term but elastic in the long term to the harvested area of paddy in that year, whereas in the paddy productivity approach it can be seen that paddy productivity in year t-2 has an inelastic elasticity value in the short and long term on paddy productivity in year t.

Keywords: *Nerlove Adjustment, Supply Response, Harvested Area, Productivity, Elasticity.*

1. INTRODUCTION

Food commodities have a very important role in people's daily lives as a source of staple food. One of the food commodities that is the most staple food for countries in Asia is paddy [15]. According to the data from Central Bureau of Statistic [3], it can be seen that the level of rice consumption in Indonesia in 2019 was 118.66 kg/cap/year while the consumption of maize and soybeans was only 1.45 kg/cap/year and 11.18 kg/cap/year. Therefore, most of the Indonesian population demands a continuous supply of paddy commodities that is evenly distributed and at an affordable price [2].

Sleman Regency is the largest producer of paddy and fisheries in the Special Region of Yogyakarta. Based on Central Bureau of Statistic Sleman Regency [4], Sleman Regency has an area of 1,327 hectares of paddy fields which is the largest land use in Special Region of Yogyakarta. The amount of rice consumption in Sleman Regency is the highest food consumption in Special Region of Yogyakarta at 88.30 kg/cap/year while the availability of paddy stocks in Sleman Regency in 2019 is 521,525 tons. The main problem in fulfilling the sufficiency of paddy in Sleman Regency at this time is the growth in demand for food commodities which is faster than the supply growth. The rapid increase of demand influenced by an increase in population, economic growth, an increase in people's purchasing power, and changes in tastes.

The sufficiency of paddy can be known based on the level of supply and demand so that there is no scarcity or excess of paddy in the market that can harm consumers and farmers as rice producers. Farmer's decisions in allocating their resources such as land, labor, and farm funds are determined by farmers responses to prices, government policies and other factors that occur. The success of increasing production will be determined from the response of farmers, which in the end farmers will make decisions on production, and the types of business activities carried out [16].

Based on [18] we can know that this research investigated the supply response of paddy in Khyber Pakhtunkhwa with time series data from 1976 to 2010. This research used data showed stationarity at one lag. The short-term and long-term elasticity estimated are 0.597 and 1.481 for production, 0.037 and 0.091 for price and −0.066 and −0.163 for substitution commodities (maize) showing inelastic relation of production with lag production, lag price and lag competitive crop price except lag production in long-term. Based on research by [1] it can be seen this research used descriptive method with time series data in 2001 to 2016, the short-term and long-term elasticity values of the paddy harvested area in year t are 1.740 and 2.413 elastic. The value of the short-term elasticity of paddy prices in year t-1 of 0.818 is inelastic and the long-term elasticity of 1.134 is elastic. The value of short-term and long-term elasticity of maize prices in year t-1 is -1.352 and -1.875 is elastic. The short-term elasticity value of the average rainfall in year t is 0.890 which is inelastic and -1.234 is elastic in the long term.

In the research of [16] it can be seen that the Nerlove supply response model approach used as analytical method with time series data from 1981 to 2013. The results shows that the elasticity of Indonesia's paddy supply in the short-term is 0.088 and the long-term elasticity is 0.153. This shows that farmers have a response to price changes. This elasticity value is in the inelastic range with the percentage change in supply being smaller than the price, which is 0.088 percent in the short term and 0.153 percent in the long-term as a result of a 1 percent change in the price of grain. The aims of this research are: (1) to identify and analyze the variables that affect the paddy supply response in Sleman Regency. (2) to identify the level of elasticity of paddy supply in Sleman Regency.

2. METHODOLOGY

This research used an analytical descriptive method with time series data for 30 years from 1990 until 2019 sourced from the Central Bureau of Statistics of Indonesia, Central Bureau of Statistics of Sleman Regency, the Agriculture, Food, Fisheries Service of Sleman Regency, and related agencies. The type of data used is secondary data. The purposive method is a method of determining location intentionally because there are reasons for knowing the properties of the location. The model used is the supply response model of Nerlove [12]. The model built is a single equation consisting of two equations, namely the model of harvested area and the model of paddy productivity.

2.1. Response to Paddy Supply in Sleman Regency

This research used multiple linear regression data analysis on the supply function by approaching the area of paddy harvested area, mathematically formulated by Equation (1) [13]:

$$A_t = b_o + b_1 P_{t-1} + b_2 Q_{t-1} + b_3 A_{t-1} + b_4 Ps_{t-1} + b_5 Purea_t + e \quad (1)$$

The paddy area response function model is developed by assuming that a farmer will formulate the optimal use of his production factors at the desired level. In this study, it is assumed that farmers want to use their land optimally at the expected level (A_t^*). In general, the desired planting area depends on the price variable which is formulated as follows:

$$A_t^* = b_o + b_1 P_{t-1} + b_2 Q_{t-1} + b_3 A_{t-1} + b_4 Ps_{t-1} + b_5 Purea_t + e \quad (2)$$

The value of the A_t^* variable cannot be observed empirically so that Equation (2) cannot be predicted directly. Therefore, there needs to be a certain formula that estimates the A_t^* value. The actual planted area (At) is not as large as the expected level. The Nerlove model mathematically formulates the relationship between the actual planted area and the expected planting area as follows:

$$A_t - A_{t-1} = \lambda (A_t^* - A_{t-1}) \quad (3)$$

Equation (3) must be in condition $0 \leq \lambda \leq 1$
When Equation (2) was substituted into Equation (3) it can be obtained in Equation (4) or Equation (5):

$$A_t = \lambda (b_o + b_1 P_{t-1} + b_2 Q_{t-1} + b_3 A_{t-1} + b_4 Ps_{t-1} + b_5 Purea_t + e) + (1-\lambda) A_{t-1} \quad (4)$$

or

$$A_t = \lambda b_o + \lambda b_1 P_{t-1} + \lambda b_2 Q_{t-1} + \lambda b_3 A_{t-1} + \lambda b_4 Ps_{t-1} + \lambda b_5 Purea_t + \lambda e) + (1-\lambda) A_{t-1} \quad (5)$$

Where:

A_t	: Paddy Harvested Area in year t (ha)
A_t^*	: Expected Paddy Harvested Area
P_{t-1}	: Paddy Price in year t_{-1} (Rp/kg)
Q_{t-1}	: Paddy Production in year t_{-1} (ton)
P_{st-1}	: Substitution Price in year t_{-1} (Rp/kg)
A_{t-1}	: Paddy Production in year t_{-1} (ha)
Bo	: Constanta
$b_1 – b_5$	: Regression Coefficient
λ	: Adjustment Coefficient

The supply function using the paddy productivity approach is mathematically formulated by Equation (6) [13]:

$$Y_t = b_0 + b_1 P_{t-1} + b_2 Y_{t-1} + b_3 Q_{t-1} + b_4 A_{t-1} + b_5 Ps_{t-1} + b_6 Purea_t + b_7 RF_t + b_8 W_t + e \quad (6)$$

The paddy productivity response is obtained in the same way as the areal response. Paddy productivity is thought to be a function of the nominal price lag of paddy and the area of paddy harvested. The productivity response equation is formulated in Equation (7) as follows:

$$Y_t^* = b_0 + b_1 P_{t-1} + b_2 Y_{t-1} + b_3 Q_{t-1} + b_4 A_{t-1} + b_5 Ps_{t-1} + b_6 Purea_t + b_7 RF_t + b_8 W_t + e \quad (7)$$

The actual productivity difference is a certain proportion of the expected productivity change. Mathematically specified as follows:

$$Y_t - Y_{t-1} = \lambda (Y_t^* - Y_{t-1}) \quad (8)$$

Equation (7) is substituted into Equation (8) to get the Equation (9) or Equation (10):

$$Y_t = \lambda (b_0 + b_1 P_{t-1} + b_2 Y_{t-1} + b_3 Q_{t-1} + b_4 A_{t-1} + b_5 Ps_{t-1} + b_6 Purea_t + b_7 RF_t + b_8 W_t + e) + (1-\lambda) Y_{t-1} \quad (9)$$

or

$$Y_t = \lambda b_0 + \lambda b_1 P_{t-1} + \lambda b_2 Y_{t-1} + \lambda b_3 Q_{t-1} + \lambda b_4 A_{t-1} + \lambda b_5 Ps_{t-1} + \lambda b_6 Purea_t + \lambda b_7 RF_t + \lambda b_8 W_t + \lambda e) + (1-\lambda) Y_{t-1} \quad (10)$$

Where:

Y_t : Paddy Productivity in year t
Y_t^* : Expected Paddy Productivity
Y_{t-1} : Paddy Productivity in previous year
A_t : Paddy Harvested Area in year t (ha)
P_{t-1} : Paddy Price in year t_{-1} (Rp/kg)
P_{st-1} : Substitution Price in year t_{-1} (Rp/kg)
Q_{t-1} : Paddy Production in year t_{-1} (ton)
A_{t-1} : Paddy Harvested Area in year t_{-1} (ha)
P_{ureat} : Urea Fertilizer Price in year t (Rp/kg)
RF_t : Rainfall Amount on year t (mm)
W_t : Wages of Farmers in year t (Rp/day)
B_o : Constanta
$b_1 – b_8$: Coefficient Regression
λ : Adjustment Coefficient

2.2. Paddy Supply Elasticity

The elasticity of paddy supply in the short term can be determined by using the following Equation (11):

$$E_{SR} = bi \frac{\bar{x}}{y} \quad (11)$$

Equations that use the natural logarithm model can be found using the following Equation (12):

$$E_{SR} = bi \quad (12)$$

Where:

E_{SR} : Short Run Elasticity
b*i* : Coefficient of Independent Variabel of *i*
$\underline{x}$: Average of Independent Variabels
$\underline{y}$: Average of Dependent Variabels

Long-term elasticity can be known after short-run elasticity is known. Long-term elasticity is formulated by Equation (13).

$$E_{LR} = \frac{bi}{\lambda} \quad (13)$$

Where:

E_{LR} : Long Run Elasticity
bi : Coefficient of Independent Variabel of *i*
λ : Adjustment Coefficient

The value of the adjustment coefficient is obtained from Equation (14):

$$\lambda = 1 - biXi \quad (14)$$

Where:

λ : Adjustment Coefficient
b_i : Independent Variabels Regression Coefficient
X : Independent Variabels

Based on the response of the paddy harvested area and the response of paddy productivity, the elasticity (response) of supply can be estimated by the following Equation (15) [12]:

$$(Q) = E(AP) + E(YP) \quad (15)$$

Table 1. Results of Regression Model of Paddy Harvested Area Response in Sleman

Variable	Expected Value	Reg. Coefficient	Std. Error	t-Statistic	Prob.
Constanta		3.122,13	5.460,48	0,571	0,573
Paddy Price in year t_{-1}	+	0,903***	0,266	3,393	0,003
Paddy Production in year t_{-1}	+	0,066***	0,021	3,145	0,004
Paddy Harvested Area in year t_{-1}	+	0,486**	0,189	2,561	0,017
Substitution Price in year t_{-1}	-	-1,470**	0,607	-2,42	0,024
Urea Fertilizer Price in year t	-	1,168**	0,511	2,286	0,032
R-squared	0,834	Mean dependent var			46.582,14
Adjusted R-squared	0,798	S.D. dependent var			3.216,77
F-statistic	23,072	Durbin-Watson stat			2,318
Prob(F-statistic)	0,000				

Source: Authors Analysis, 2021

Where:

*** Significant at the level of confidence 99 %
** Significant at the level of confidence 95%

The following criteria for elasticity both in the short and long run [15]:

1. E < 1; Inelastic, every 1 percent change in the independent variable will result the changes of dependent variable less than 1 percent.
2. E = 1; Uniter, every 1 percent change in the independent variable will result the changes of dependent variable equal to 1 percent.
3. E > 1; Elastic, every 1 percent change in the independent variable will result the changes dependent variable by more than 1 percent.

3. RESULT AND DISCUSSION

3.1. Study Area of Sleman Regency

The area of Sleman Regency is 57,482 ha or about 18 percent of the total area of the Special Region of Yogyakarta. Administratively, Sleman Regency consists of 17 sub-districts, 86 villages, and 1,832 hamlets [4]. Most of the population of Sleman Regency make a living in agriculture approximately 124,992 people with Gamping Subdistrict being the subdistrict with the largest population working in the agricultural sector with 11,883 people, although there was a decrease from the previous year. However, the agricultural sector is still the sector with the most employment in Sleman Regency, followed by other service sectors, finance and rental, as well as trade and hotels [4].

The food crops production in Sleman Regency is dominated by paddy. However, land use in Sleman Regency is dominated by non-agricultural use of 19,766 ha, followed by non-agricultural use of 19,544.7 ha, and the rest is used for paddy fields covering an area of 18,135 ha while the largest area of paddy fields is in Ngemplak District covering 1,632 ha and the smallest in Turi District, covering an area of 272 ha [4]. Based on this, it can be seen that the use of paddy fields is still smaller than other sectors. The total area of rice harvested in Sleman Regency is 44,192 ha with a total production of 235,945,068 tons. Minggir sub-district is the sub-district with the highest total production with 19,379.04 tons, while the smallest production is in Turi sub-district with 2,954,434 tons [4].

3.2. Results of the Estimation of Paddy Harvested Area Model in Sleman Regency

According to [14], it can be seen that the paddy harvest area approach is one of the important variables that can affect paddy supply. Econometrically, the relationship between the independent variables on the area of paddy harvested in Sleman Regency can be analyzed by the following Equation (16). The regression equation obtained based on the regression results contained in Table 1. is as follows.

$$At = 3.122{,}132 + 0{,}903P_{t-1} + 0{,}066Q_{t-1} + 0{,}486A_{t-1} - 1{,}470Ps_t + 1{,}168Pureq_t + e \quad (16)$$

Based on Table 1. it can be seen that the coefficient of determination is 0.798, which means that 79.8 percent of the variation dependent variable (paddy harvested area in year t) can be explained by the independent variables in the model (paddy price in year t_{-1}), paddy productivity in year t_{-1}, paddy production in year t_{-1}, maize price in year t_{-1}, and urea fertilizer prices in year t) while the 20.2 percent variation was explained by other variables outside the model. The results of the F-test showed that the probability value of F was 0.0000 which was smaller than the significance level (α = 1%, 5%, and 10%) so that was rejected the Ho hypothesis and it can be seen that the paddy price variable in year t_{-1}, paddy productivity in year t_{-1}, paddy production in year t_{-1}, maize price in year t_{-1}, and urea fertilizer price in year t as together have a significant effect on the area of paddy harvested in year t.

The t-test estimation results show the t-statistic probability value on the paddy price variable in year t_{-1} individually showing significance at the 99 percent confidence level with a value of 0.0025 < 0.01. The paddy production in year t_{-1} individually showed significance at the 99 percent confidence level with a value of 0.0045 < 0.01. Paddy harvested area in year t_{-1} individually showed significance at the 95 percent confidence level with a value of 0.017 < 0.05. Maize price in year t_{-1} individually shows significance at the 95 percent confidence level with a value of 0.024 <0.05. Urea fertilizer price in year t individually shows significance at the 95 percent confidence level with a value of 0.032 <0.05.

3.3. Estimation Result of Paddy Productivity Model in Sleman Regency

According [9] it can be seen that the paddy productivity approach is used as an indicator of efficiency in the production system of an agricultural commodity. Econometrically, the relationship between the independent variables on paddy productivity in year t using the natural logarithm form can be analyzed by the following equation. The regression Equation (17) obtained based on the regression results in Table 2. is as follows.

$$Ln(Y_t) = 0{,}940 - 0{,}004Ln(P_{t-1}) + 0{,}422Ln(Y_{t-2}) + 0{,}361Ln(A_t) - 0{,}581Ln(A_{t-1}) + 0{,}096Ln(P_{st-1}) + 0{,}149Ln(Purea_t) + 0{,}088Ln(RF_t) + 0{,}142Ln(W_t) + e \quad (17)$$

Based on the regression results in Table 2. it can be seen that the value of the coefficient of determination is 0.621, which means that 62.1 percent of the variation of the dependent variable (paddy productivity in year t) can be explained by the independent variables in the model

Table 3. Elasticity Value of Paddy Harvested Area Approach

Variable	Elasticity			
	Short-Term	Category	Long-Term	Category
Paddy Price in year t_{-1}	0,056	Inelastic	0,109	Inelastic
Paddy Production in year t_{-1}	0,385	Inelastic	0,412	Inelastic
Paddy Harvested Area in year t_{-1}	0,9	Inelastic	9,26	Elastic
Substitution Price in year t_{-1}	-0,114	Inelastic	-0,046	Inelastic
Urea Fertilizer Price in year t	0,063	Inelastic	-0,38	Inelastic

Source: Authors Analysis, 2021

(paddy prices in year t_{-1}, paddy productivity in year t_{-2}, paddy production in year t_{-1}, paddy harvested area in year t_{-1}, price of substitute commodity (maize) in year t_{-1}, and the price of urea fertilizer in year t, the level of rainfall amount in year t, and wages of farmers in year t) while 37.9 percent of the variation is explained by other variables outside the model.

Based on the results of the F test, the probability value of F is 0.000 which is smaller than the significance level (α = 1%, 5%, and 10%) so that it rejects the Ho hypothesis and it can be seen that the paddy price variable in year t_{-1}, paddy productivity in year t_{-2}, paddy harvested area in year t, paddy harvested area in year t_{-1}, maize price in year t_{-1}, urea fertilizer price in year t, rainfall amount in year t, and wages of farmers in year t) as together have a significant effect on the paddy productivity variable in year t.

The estimation results of the t-test show the probability value of the t-statistic on the paddy productivity variable in year t_{-2} shows significance at the 95 percent confidence level with a value of 0.045 < 0.05. Meanwhile, in the variable paddy price in year t_{-1}, paddy production in year t_{-1}, paddy harvested area in year t_{-1}, maize price in year t_{-1}, and urea fertilizer price in year t, rainfall amount in year t, and wages of farmers in year t individually are not significant to the paddy productivity variable in year t.

3.4. Elasticity of Paddy Supply in Sleman Regency

The elasticity of supply is a quantity that shows the percentage change in the dependent variable as a result of changes in the independent variable. One of the main characteristics of agricultural products is the grace period between planting and harvesting which is called the gestation period or lag [18]. Farmer responses occur due to differences in lag as a result of changes in input prices, outputs, and government policies [5]. According to [15] in the elasticity of supply, there are two terms, namely short-term elasticity and long-term elasticity. The regression results obtained in this study based on the approach of paddy harvested area and paddy productivity show the elasticity of paddy supply in the short and long term are shown in Table 3. and Table 4.

Based on Table 3. it can be seen that the elasticity of the paddy harvested area in year t for changes in paddy prices in year t-1 in the short term and long term is 0.056 and 0.109, respectively. This shows that an increase in paddy prices in year t-1 of Rp. 1 will increase the area of paddy harvested in year t by 0.056 ha in the short term and 0.109 ha in the long term. Based on the elasticity value in the short and long term, it can be seen that the paddy harvested area in year t has an inelastic response to changes in paddy prices in year t-1 because paddy prices tend to be more stable so farmers tend to be less responsive to response the changes in paddy prices that occur for increase the area of paddy harvested.

This is following the research of [7] where farmers have a slow response to changes in the selling price of paddy because the increase in the selling price of paddy is not matched by an increase in paddy production and fluctuations in the real price of grain at the farm level. The law of supply shows that a price increase will increase the supply of the commodity assuming the values of the other variables in the supply function are held constant (cateris paribus) [22]. Farmers will tend to plant paddy when the selling price of paddy in year t-1 increases so that it can increase the area of paddy harvested in that year [19].

However, the decreasing paddy prices in year t-1 will prevent farmers from increasing the area of paddy harvested and the number of inputs used because they do not want to suffer losses due to the large production costs that are greater than the profits. The long-term elasticity of paddy prices in Sleman Regency is higher than the short-term elasticity and it can also be concluded that farmers in Sleman Regency are commercial farmers in

the long term because they take into account the price aspect in carrying out farming activities even though they do not have a responsive enough response [20].

Based on the elasticity value of the paddy harvested area in year t, the changes in the paddy production in year t_{-1} in the short term and long term are 0.385 and 0.412, respectively. This shows that an increase in the amount of paddy production in year t_{-1} by 1 ton will increase the paddy harvested area in year t in the short term by 0.385

ha and in the long term by 0.412 ha but is not responsive to changes in the amount of paddy production in year t_{-1} in the short and long term. This is following the research of [20] where farmers are less responsive to changes the amount of paddy production because the amount of paddy production in year t_{-1} has a small margin even though it shows a positive influence on the area of paddy harvested in year t because farmers will evaluate the paddy production results in the previous one-year period and will respond in the area of paddy harvest in that year [20]. According to [25], it is known that the increase in paddy production has a positive relationship with the increase in paddy harvested area. Paddy supply response can be increase in short-term by expanding the paddy harvested area and in long term by increasing paddy production or improving efficiency of conversion from paddy to rice [25].

Non-price factors such as production area was dominated the supply response of various crops over price factors [6]. The elasticity value of the harvested area in year t for changes in the area of paddy harvested in year t-1 in the short term and long term shows results of 0.9 and 9.26, respectively, which are the most positive variables in the approach to paddy harvested area. This shows that an increasing harvested area in the year t-1 by 1 ha will increase the paddy harvested area by 0.9 ha in the short term and 0.926 ha in the long term. These results are supported by the research results of [7] where the effect of changes in harvested area in year t-1 on the harvested area in year t shows inelastic changes in the short term. According to [23], the relationship between paddy harvested area in the previous year and paddy harvested was positive. Farmers can increase paddy harvested area for paddy farming to ensure responsiveness of paddy supply [6].

The lag of paddy harvested area increases the responsiveness of paddy supply which means increased capacity to help paddy farmers through easy access to information and development as well as urging them to use additional areas for paddy farming to ensure the sufficiency paddy supply in the country [6]. Farmers tend to be less responsive to changes in the paddy harvested area in the previous year because the paddy harvested area is generally relatively the same and has a small margin of change from the previous year. Paddy harvested area is a variable that is easy controlled by farmers in terms of the amount of production. The increase in the paddy harvested area in the previous year will motivate farmers to expand the planting area so that the paddy harvested area can increase, especially in the long term [7]. This confirms that land is one of the contributors to the increasing paddy supply, but due to the narrower land tenure, the supply will decrease where there is a significant decrease in the area of paddy fields in Sleman Regency by 25 percent from 2014 to 2019 [4].

The elasticity of the paddy harvested area in year t on changes in the price of substitute commodities (maize) in year t-1 has a negative effect in the short and long term was known -0.114 and -0.046, respectively. This shows that an increase in the price of a substitute commodity (maize) in year t-1 of Rp. 1 will reduce the area of paddy harvested in year t by 0.114 ha in the short term and 0.046 ha in the long term. Based on the results of the analysis that has been carried out, it can be seen that the substitute commodities (maize) price in year t_{-1} has an inelastic response in the short and long term where every decrease in maize prices in the previous year will increase the area of paddy harvested and vice versa. This is following the research results of [4] where the price elasticity of maize in year t_{-1} has an inelastic value in the short and long term because it is less responsive to changes in the area of paddy harvested.

Farmers tend to be less responsive to changes in the paddy harvested area in the previous year because the paddy harvested area is generally relatively the same and has a small margin of change from the previous year. Paddy harvested area is a variable that is easy controlled by farmers in terms of the amount of production. The increase in the paddy harvested area in the previous year will motivate farmers to expand the planting area so that the paddy harvested area can increase, especially in the long term [7]. This confirms that land is one of the contributors to the increasing paddy supply, but due to the narrower land tenure, the supply will decrease where there is a significant decrease in the area of paddy fields in Sleman Regency by 25 percent from 2014 to 2019 [4].

One of the factors that often affect changes in maize prices is seasonal factors such as when the harvest season occurs, the selling price of paddy becomes very low due to high paddy supply while the selling price of maize commodities in the previous year is known to be higher so that the farmers assume that planting maize when Decreased paddy prices will be more profitable than growing paddy and the area harvested for paddy in that year will decrease [1]. Furthermore, the replacement of this commodity will cause the paddy harvested area to shrink in that year which will have an impact on decreasing paddy supply in Sleman Regency due to the increase in the selling price of maize harvest.

Changes in the urea fertilizer price in year t to the paddy harvested area in year t have a response in the short term and long term of 0.063 and -0.38, respectively. This shows that an increase in the price of urea fertilizer in

year t of Rp 1 will increase the paddy harvested area in year t in the short term by 0.063 ha and decrease in the long term by 0.38 ha and wasn't responsive to changes in urea fertilizer prices in year t in both the short and long term. The use of fertilizers by farmers is highly dependent on the area of land used. The more land used, the amount of fertilizer used will increase.

Table 4. Elasticity Value of Paddy Productivity Approach

Varible	Elasticity			
	Short Run	**Category**	**Long Run**	**Category**
Ln(Paddy Productivity in year t_{-2})	0,422	Inelastic	0,73	Inelastic

Source: Authors Analysis, 2021

In this study, it is known that every increase in fertilizer prices will increase the area of paddy harvested in Sleman Regency in the short term. This is not following the research of [24] where an increase in the price of urea fertilizer in an area will reduce the paddy harvested area because farmers will reduce the use of the paddy harvested area when the price of urea fertilizer increases. The anomaly that occurred in this research to changes in the urea fertilizer price in that year was caused in the short term the use of fertilizer could still be made efficient so that the paddy harvested area continued to increase when the price of urea fertilizer that year increased [17].

On the other hand, in the long term, any increase in the price of urea fertilizer in year t will reduce the area of paddy harvested in year t because farmers will respond by reducing the area of paddy harvested when they see the urea fertilizer price increases in the long term. This is following the research results of [17] where an increasing urea fertilizer price in that year will reduce the area harvested in that year because farmers will run into losses when using urea fertilizer at high prices in the long term.

Based on the results of testing the elasticity of paddy supply in Sleman Regency with the paddy productivity approach model in Table 4. shows that only paddy productivity in year t_{-2} has a significant effect on paddy productivity that year in Sleman Regency because farmers in Sleman Regency didn't respond to changes in the paddy price variable in t_{-1}, paddy harvested area in year t, paddy harvested area in year t_{-1}, maize price in year t_{-1}, urea fertilizer price in year t, rainfall amount in year t, and wages of farmers in year t to increase the productivity of paddy in year t.

This is following the results of research by [8] which shows that paddy productivity in year t can be significantly affected by the area of paddy harvested in year t_{-1} and the amount of paddy production in year t_{-1}. However, based on the data used, it can be seen that there were quite large fluctuations in the area of paddy harvested in year t_{-1} and the amount of paddy production in year t_{-1} so that it could not be seen that it had a significant effect on paddy productivity in year t_{-1} and in following the research of [20] shows that changes in the area of paddy harvested and the amount of paddy production have no significant effect on paddy productivity due to changes between the two variables which are highly volatile and influenced by other factors such as the conversion of paddy fields and failure of production of paddy commodities.

Based on Table 4. it can be seen that the elasticity value of paddy productivity in year t of changes in paddy productivity in year t_{-2} has a positive effect in the short and long term, respectively 0.422 and 0.730. This shows that an increase in paddy productivity in year t_{-2} of 1 Ku/ha will increase paddy productivity in year t in the short term by 0.422 Ku/ha and in the long term by 0.730 Ku/ha and has a positive effect on paddy productivity in year t which means an increase paddy productivity in year t_{-2} will increase paddy productivity in year t but has an inelastic response in the long and short term.

This is because productivity is very dependent on the amount of production produced and the area of paddy harvested so that farmers cannot directly respond to paddy productivity in the following year [10]. Paddy productivity in year t_{-2} can determine farmers response to paddy productivity in year t because the dynamics of changes in paddy productivity can occur within of two years [21]. In addition, the productivity of paddy plants is influenced by several factors such as the variety of paddy used, the amount of use of chemical fertilizers, rotation and spacing, the use of planting tools, pest control, and planting time [11].

4. CONCLUSION

Based on the paddy harvested area approach, it is known that the paddy price in year t_{-1}, paddy production in year t_{-1}, and paddy harvested area in year t_{-1} have a positive effect, while the substitute commodity (maize) price in year t_{-1} and urea fertilizer price in year t have a negative effect on the paddy harvest area in year t_{-1}. In the result of the paddy productivity approach, it can be seen that only paddy productivity in year t_{-2} has a positive effect on paddy productivity in year t_{-1}. Based on the

paddy harvested area approach, it can be seen that the price elasticity of paddy t_{-1}, the amount of paddy production t_{-1}, substitute commodity (maize) price in year t_{-1}, and urea fertilizer price in year t are not responsive in the short and long term and the paddy harvest area in year t_{-1} is not responsive in the short term but quite responsive in the long term to the paddy harvested area in year t while the paddy productivity approach can be seen that the paddy productivity in year t_{-2} has an elasticity value that is not responsive in the short and long term to paddy productivity t.

Based on these conclusions, the suggestions that can be given to the Sleman Regency Government with the service are to determine policies to increase farmers responses to paddy supply in Sleman Regency by providing fertilizer subsidies to reduce production costs and providing more best quality seeds to create an increase in the amount of production and paddy productivity levels, determining the price policy because it can provide positive incentives to the supply of paddy in Sleman Regency, as well as the establishment of policies that regulate the sustainable use of paddy agricultural land areas so that the rate of land conversion can be suppressed.

AUTHORS' CONTRIBUTIONS

Adi Britanianto presented the idea, collected data, performed analysis data, and wrote the manuscript. Mrs. Dr. Ir. Lestari Rahayu Waluyati, M.P. and Mrs. Azizatun Nurhayati, S.P., M.Sc. checked and supervised the research result and give critical feedback for the manuscript.

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