Alocative Efficiency of Honey Pineapple Farm in Pemalang Regency, Central Java, Indonesia

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Abstract. Pineapple Honey is one of the superior commodity of Pemalang Regency, Central Java. However, production of honey pineapple in 2013-2015 was occurred fluctuations. The purpose of this research is to know the factors that affect production and to know the level of elasticity in each honey pineapple farming input in the Beluk Village. The sampling of locations was carried out purposively with the consideration that beluk village was the centre of honey pineapple production. The number of samples was 64 farmers who were taken simple random. Cobb-Douglas production function analysis technique was used to determine the factors affecting the production and elasticity of each of the honey pineapple farming inputs. The results of the analysis showed that the factors affecting the production of honey pineapple are the number of plants, manure, and harvest season. In variables that affect production is obtained only variable manure has negative value. It can be occurred as effect of the application of immature manure. So, we suggest that the use of manure that is ripe and of good quality will have a positive effect on the growth and production of honey pineapple.

1 Introduction

Honey pineapple is one of the local varieties of pineapple from Pemalang, Central Java. This fruit has a characteristic shape of a fruit that is relatively smaller than pineapple in general, but it is preferred by the public because of its sweet taste. Some of these honey pineapple fruits are marketed directly in the form of fruit and in processed forms such as chips, syrup, fruit juice drinks, and lunkhead. This aims to increase the selling value of pineapple honey in the Pemalang area. The processing of honey pineapple fruit greatly affects the economic level of honey pineapple farmers and people who set up home-based businesses for processing products in the Pemalang area.

The construction of the pineapple monument was founded in early 2017 by Pemalang district government in collaboration with the City Planning Agency. Pemalang Regency is one of the typical Pemalang honey pineapple producers which is the reason for being the canter for honey pineapple fruit production. The high production of honey pineapple is influenced by the empowerment and counselling of honey pineapple farmers which the Pemalang Regency Government always pays attention to. This can be seen from the

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amount of data on honey pineapple production which is quite a lot in Pemalang district as follows.

Table 1. Total Honey Pineapple Production in Pemalang Regency, 2013-2015

Distric	Production (Ton)		
	2013	2014	2015
Moga	-	-	-
Pulosari	20	-	130
Belik	**107,380**	**139,160**	**27,162**
Watukumpul	2	3	22
Bodeh	9	-	-
Randudongkal	1	4	328
Pemalang	**107,412**	**139,281**	**27,647**

Source: Pemalang Regency Statistics Agency 2016

Based on the data provided in table 1, it is understood that substantial fluctuations were observed in honey pineapple in Pemalang Regency at the beginning of 2013-2015. In 2013, the production of honey pineapple was 107,412 tons and there was an increase in 2014 with the total number of production in all sub-districts in Pemalang Regency of 139,281 tons, while in 2015 pineapple production had decreased significantly from the previous year, namely with a production of 27,647 tons [1].

Generally, honey pineapple cultivation is carried out during the dry season. In implementing honey pineapple cultivation, farmers use manure and flower stimulant fertilizers in addition to land, seeds, and labor. Therefore, it is necessary to research what factors affect the production and how efficient the use of these production factors is in honey pineapple farming in Pemalang Regency. This study aims to (1) identify the factors affecting the growth of honey pineapple farming, and (2) recognize the efficiency of the use of input production factors in honey pineapple farming, based on the problems mentioned above.

Research on the factors that influence farm production has been conducted by several previous researchers. Zhang, Yan, & Sun, (2016) found fertilizer costs, irrigation costs, and machine costs all positively and significantly affect wheat production. Rice production is influenced by the previous year's rice harvest area, rice imports, urea fertilizer prices, real exchange rates and rice prices in the domestic market [3]. The area of arable land, the number of effective labor, the amount of fertilizers, the amount of pesticides, the distance of arable land from the farmer's house, and the irrigation system all influence the increase in lowland rice production [4]. The production of lowland rice farming is also influenced by land area, use of seeds, use of urea fertilizer, phonska fertilizer, pesticides, total labor, age of farmers, frequency of farmer guidance and irrigation [5].

Research on the use of agricultural production factors for plantation and horticultural crops has also been conducted by previous researchers. We have read that the factors that influence cocoa production in Muaro Jambi Regency are labor, manure, chemical fertilizers, arable land area and partnerships, while education level negatively affects cocoa production [6]. The results of the research by Ibitoye et al, (2011) stated that 13.3% of oil palm farmers complained about planting fake seeds obtained from nurseries. Meanwhile [8] have examined the factors that influence vegetable production, namely the area of land cultivated, the multiple planting index, the proportion of vegetable cultivation and vegetable yield per hectare in China.

The findings of the Ying & Min [9] (2011) study indicate that the relative prices of secure agricultural goods, the size of production, government subsidies, agricultural technician guidance and joining organizations for agricultural industrialization have a major

positive impact, whereas the age of the farmer and family income have a negative effect. Important to farmers' willingness to produce healthy agricultural products. Meanwhile, Qiao, (2017) found that wage increases and mechanization had a negative impact on land areas devoted to labor-intensive crops but had a positive impact on land areas devoted to extensive crops. In this connection, Mabuza et. al (2013) found that tractor use was significantly influenced by household wealth and the size of arable land used by households. In general, the biggest influence on agricultural yield is chemical fertilizers and the strength of the second agricultural machine [12].

Changes in input use have an impact on changes in output as a level of elasticity of production. Lin & Fei (2015) found that the alternatives for each other are capital, labor and energy, but the elasticity of substitution between capital and energy is the greatest. Meanwhile in the agricultural sector in China, labor elasticity decreases, the elasticity of fertilizers and machines increases, and soil elasticity has a U-shaped curve over time (Gong, 2018).

The ability of farmers to allocate agricultural production inputs will have an impact on the level of farm efficiency. Shavgulidze, et.al (2017) have stated that crop protection measures and the use of quality seeds to be significant aspects affecting the technical efficiency of potato farmers. Meanwhile Chaovanapoonphol & Somyana, (2018) found that the efficiency of maize farmers' contracts in Laos was 0.85 on average and that the main factors affecting the efficiency of maize production were the age and education level of farmers and the area of land planted. To achieve efficiency, rice producers in southwest Niger can reduce their input by 52% (Boubacar et al, 2017). Rondhi[18] dan Defidelwina [19] found that land ownership affects the efficiency of rice farming. In addition, wage labor, family labor, seeds, feed and other costs were identified to positively affect the output of fish ponds by increasing the scale of yield (Onumah, 2018).

Research on vegetable and fruit crops as well as plantation crops has been studied by previous researchers. The efficiency of root-based vegetable production factors has been researched by (Ajapnwa et al, 2017) showing that manure is the most productive factor input, followed by agricultural equipment and labor, while irrigation costs, land area, non-agricultural employment opportunities, the ratio of apple planted area and fertilizer prices has a significant positive effect on the efficiency of fertilizer use in apple production [22]. Meanwhile (Lemos et al, 2019) stated that 40 best practices were developed to observe, improve, and control indicators for increasing the global efficiency of agro-industrial production units in sugarcane production. In addition, The decline in wine prices has contributed to a rise in the productivity of wine-producing firms compared to a substantial decrease among companies dedicated solely to the manufacture of wine. (Urso et al, 2018).

Efficiency research related to the use of technology, the environment and different business scales has also been studied by several previous researchers. Benedetti, Branca, & Zucaro (2019) have researched and stated that organic farming tends to have a lower level of technical efficiency compared to conventional farming. Meanwhile, smallholder conservation farming (CA) practices in Cambodia show significant yield gains and a significant contribution to food production (Ndlovu et al, 2014). However, the agro-climatic conditions both maximum temperature and rainfall (flooding) are major contributors to technical inefficiency in Bangladeshi rice farming (Mishra et al, 2015).

Research on pineapple commodities has been carried out by Gangopadhyay & Mukherjee (2015) showing that as reported in the Indian (Ratu) pineapple (Ananas comosus (L.) Merr) 'elite' variety, a comprehensive protocol using a standard plant transformation vector (pCAMBIA1304) can be applied to other pineapple varieties to introduce the target genes. This result is still the development of seed technology, not yet developing aspects of cultivation and farming for efficiency. We have not found a study on input allocation and efficiency of pineapple farming. Therefore, this paper will discuss the

production of local varieties of pineapple farming, namely honey pineapple in relatively traditional farming in Central Java.

2 Research Method

The research was conducted in Beluk Village, Belik District, Pemalang Regency with the consideration that Beluk Village is a central village for the development of superior honey pineapple commodities in Pemalang Regency. This study took samples from three farmer groups namely Ngudi Tani I, Trubus II and Sumber Nanas. The number of population of farmer groups selected based on the criteria that are still active is 386 farmers. According to (Nasution, 2003) determining the number of samples can use the following formula:

$$n = \frac{NZ^2S^2}{Nd^2 + Z^2S^2} \quad \text{.....(1)}$$

Information:
n = Number of samples
N = Total population
Z = Degree of confidence (95% = 1.96)
S^2 = Sample variant (5%)
d = Degree of deviation (5%)

Based on this formula, the number of samples obtained was 64 farmers. The number of samples from each group was taken by proportional random sampling, namely Ngudi Tani farmer group 19 farmers, Trubus II 17 farmers, and Sumber Nanas 28 farmers.

This study used Pemalang honey pineapple production data in 2018 which was analyzed using the Cobb-Douglas production function. The calculation of the Coub-Douglas production function can estimate the elasticity of each production input variable. According to [30] and [31] the Cobb-Douglas function is a function or equation that involves two or more variables, where one variable is called the dependent variable (Y), and the other is called the independent variable (X). The Cobb-Douglas function equation is a power function. Mathematically, the Coub-Douglas function can be written as follows.

$$Y = \beta_0 X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3} X_4^{\beta 4} X_5^{\beta 5} D e^{u} \quad \text{.....(2)}$$

Information :
Y: Dependent variable (pineapple honey production)
β_0: Constant
X_1: Land area
X_2: Number of plants
X_3: Manure
X_4: Flower stimulant
X_5: Labor
D: Growing season (Dummy, 1 = dry, 0 = rainy)
$\beta_1..\beta_5$: Independent variable regression coefficient
e: Natural logarithm (2,718)
u: Error

It is transformed into a multiple linear form for estimation of the above equation by transforming it into the ln form (natural logarithm) so that the equation becomes.

$$\text{Ln}Y = \text{Ln}\beta_0 + \beta_1 \text{Ln}\, X_1 + \beta_2 \text{Ln}\, X_2 + \beta_3 \text{Ln}\, X_3 + \beta_4 \text{Ln}\, X_4 + \beta_5 \text{Ln}\, X_5 + D e^{u} \quad \text{...(3)}$$

The determination coefficient (R^2) is used to express the proportion or percentage of the overall variance in the independent variable (X), which indicates how well a model's ability

to explain the dependent variable can be explained. [32]. The formula for calculating the coefficient of determination is:

$$R^2 = (ESS / TSS) = 1 - \frac{\Sigma(yi - \hat{y}i)^2}{\Sigma(yi - \bar{y}i)^2} \qquad (4)$$

Information:

R^2 : coefficient of determination
ESS : Error Sum of Square
TSS : Total Sum of Square
yi : respondent's observation i
$\hat{y}i$: the forecast of respondent i
$\bar{y}i$: average

The adjusted coefficient of determination (R^2 adjusted) is the coefficient of determination that considers (adjusted for) degrees of freedom. The degree of freedom depends on the number of explanatory variables. Mathematically, the R^2 adjusted formula is as follows:

$$Adjust\ R^2 = 1 - (1 - R^2)\frac{(n-k)}{(k-1)} \qquad (5)$$

Information:

Adjust R^2 : adjusted coefficient of determination
k : number of variables excluding intercept
n : number of samples

The F test is a variable test or model test carried out jointly to see how all the honey pineapple production variables influence the dependent variable simultaneously. The F test is formulated as follows.

$$F_{test} = \frac{ESS/(k-1)}{RSS/(n-k)} \qquad (6)$$

$$F_{tabel} = \frac{(k-1)}{(n-k)} . \alpha \qquad (7)$$

Information:

k : number of variables excluding the intercept
n : number of samples
ESS : *explained sum of square*
RSS : *residual sum of square*
α : level of significance

With the following hypothesis:

Ho: $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 = 0$ means that there is no influence of the independent variable on the dependent variable.

H1: At least one value of βis not equal to zero, it means that there is an influence of the independent variable ith, simultaneously on the dependent variable.

The test criterion is Ho is rejected and H_1 is accepted, if the value of F-test > F table at level α 0.05 on the contrary if F-test ≤ F-table, then H_0 is accepted and rejects H_1 which means the independent variable, together has no significant effect on the variable dependent.

The t-test is an individual test of the substantial effect of the independent variable on the dependent variable. The significance test is a process in which the results of the survey are used to evaluate the decision to accept or reject Ho on the basis of the statistical test value derived from the data.

1) Making the null hypothesis (Ho) and the alternative hypothesis (Ha)
2) Calculating the t test with the formula:

$$T_{test} = \frac{(bi)}{Sbi} \quad \text{.....(8)}$$

Information :
bi : Coefficient of independent variable
Sbi : Standard Error of independent variables

The decision to accept or reject Ho is based on a comparison of the significance of t and the alpha level (critical value). If the hypothesis is tested, the significance of t < α, then Ho is rejected and H_1 is accepted, meaning that there is a significant influence between one independent variable on the dependent variable. If the significance of t > α, then Ho is accepted and H_1 is rejected, meaning that there is no significant effect between one independent variable on the dependent variable.

Efficient use of production inputs will provide maximum profit. The maximum profit is obtained when the derivative of the profit function on the use of input is zero [30]. This can be formulated as follows:

$\Pi = Y.Py - X.Px$ .....(9)

Π= profit
Y = production or output
Py = opu put price
X = input
Px = input price

Then the derivative of the profit function is:

$d\Pi dx = dY/dx .Py - dX/dX.Px$ .....(10)

$d\Pi dx = dY/dx .Py - Px$

If dY/dx = marginal production (MP), then dY/dx.Py is the marginal production value (MPV). Thus the maximum profit occurs when:

$d\Pi dx = dY/dx .Py - Px = 0$ .....(11)

or

$dY/dx.Py = Px$ .....(12)

$MPV = Px$ .....(13)

This condition can be said that the production is in efficient condition. Therefore, efficiency analysis can be seen by looking at calculating the comparison between the Marginal Production Value (MPV) and the input price (Px) or it can be formulated in the form MPVx / Px = k. The provisions are as follows.

MPVxi / Pxi = 1, meaning that the use of inputs is efficient.
MPVxi / Pxi > 1, meaning that the use of input is not efficient. Therefore, to achieve an efficient level of input use needs to be added.
MPVxi / Pxi <1, meaning inefficient use of farm inputs. Therefore, to achieve an efficient level of input use must be reduced

3 Results and Discussion

3.1 Factors Affecting Honey Pineapple Production

It is important to know the factors related to the production of honey pineapple farming in Beluk Village, Belik District, Pemalang Regency, because these factors can help identify things that have a positive or negative relationship.

Table 2. Results of multiple linear regression analysis of Cobb-Douglas function on honey pineapple production factors

Variable	Coefficient	t-test	Sig
Constant	-1.136	-0.777	0.440
Land (X_1)	0.036	0.105	0.917
Plant (X_2)	1.079	2.658	0.010***
Manure (X_3)	-0.434	-2.508	0.015**
Flower Stimulance (X_4)	0.095	0.580	0.564
Labor (X_5)	0.754	1.309	0.196
Season (*D*)	0.720	3.041	0.004***
R^2	0.655		
F_{test}	18.072		
F_{table}	2.37 (α= 0.05)		
N	64		

Information: *** : Significant at α= 1%
** : Significant at α= 5%

Based on the results of the calculation, the results of the regression equation are as follows:

$$LnY = \ln -1.136 + (0.036) \ln X_1 + (1.079) \ln X_2 - (0.434) \ln X_3 + (0.095) \ln X_4 + (0.754) \ln X_5 + (0.720) \ln D + e$$

The coefficient of determination (R^2) of 0.655 indicates that the variable ability of land area (X_1), number of plants (X_2), manure (X_3), flower stimulants (X_4), labor (X_5), harvest season (D) can explain the variables. Honey (Y) pineapple production was 65.5%, while the remaining 34.5% was explained by variables outside the model or other variables such as spacing, number of clumps, harvesting system, and NPK fertilizer.

The F-tes value (18.072) is greater than the F-table value of 2.37. This shows that the hypothesis rejects Ho. This means that independently the variable land area (X_1), number of plants (X_2), manure (X_3), flower stimulants (X_4), labor (X_5), harvest season (D) together have a significant effect on honey pineapple production at the 95% confidence level.

Land area is an important factor owned by farmers in conducting a farm because with adequate land, farmers can use it as agricultural land. The t-test value of land area variable showed no significant effect on honey pineapple production at the 90% confidence level.

The number of plants affects the cultivation process because with a lot of plants there will be low losses. The t-test value of the number of plants is 2.658 with a significance value of 0.010 so that the hypothesis rejects Ho. This means that the variable number of plants has a significant effect on honey pineapple production at a 99% confidence level. The regression coefficient value of the number of plants variable is 1.079. It can be interpreted that if the variable number of plants is added by 1%, this can increase the production of honey pineapple by 1.07%.

Manure includes organic fertilizers which usually use manure from livestock such as chicken, cow, goat manure and so on. The nutrient content in manure is very good for plants compared to chemical fertilizers. The t-test value of manure is -2.508 with a significance value of 0.015, so the hypothesis rejects Ho. This means that the manure variable has a significant effect on honey pineapple production at the 95% confidence level. The regression coefficient value of the manure variable is -0.434, it can be interpreted that if the manure variable is increased by 1%, this can reduce the production of honey pineapple by 0.43%. Farmers pay less attention to the use of manure. Many farmers use immature manure. Compost that is relatively immature is phytotoxic to tomato seedlings [33]. This certainly applies to other plants such as honey pineapple. Thus, immature manure will interfere with plant growth so that it can reduce plant production.

The problem associated with manure is that manure treatment is considered less applicable in small farms. This occurs because the main obstacles to technology adoption are related to economic factors, namely lack of investment capital, high processing costs and long payback periods [34]. Therefore, the development of co-composting and additive strategies is needed in order to produce better manure compost for wider agricultural needs. These additional requested compost properties, especially those related to the stability of organic matter, can be evaluated through the use of innovative instrumental techniques. (Moral et al, 2009).

Flower stimulant is a liquid fertilizer which is applied by dropping it when the plant is mature. Generally, the honey pineapple plant is done by dropping it when the plant is 10 months old because it refers to the large size of the pineapple fruit. However, the results of the t test analysis showed that the flower stimulant variable did not significantly affect the honey pineapple production at the 90% confidence level.

Labor is an important factor in conducting a honey pineapple farming because with sufficient labor it makes it easier to cultivate honey pineapple plants. However, the results of t-test analysis showed that the labor variable did not significantly affect the production of honey pineapple.

The growing season for honey pineapples is divided into the dry season and the rainy season. The rainy season occurs from October to March while April to September generally falls in the dry season. The results of the analysis show that the t-test value is 3.041 with a significance value of 0.004, so the hypothesis is rejected. The magnitude of the difference in production is indicated by the regression coefficient value of the harvest season variable of 0.720. It can be interpreted that the production of honey pineapple in the dry season is 0.72% higher than in the rainy season. The correlation analysis of crop yields with climate variables (rainfall, minimum and maximum temperature) at the growth stage of pineapples (vegetative, flowering and yield formation) correlates with annual pineapple yields (Williams et.al, 2017).

3.2.Honey Pineapple Farming Allocative Efficiency

Based on the results of the analysis, the input efficiency value of the number of plants (X_2) was 6.25, while the manure input (X_3) was 120.1. It can be concluded that the level of efficiency in the number of plants input (X_2) and manure (X_3) has an efficiency value of more than 1 (NPM / Px> 1), meaning that the use of manure and seed input is inefficient.

The t value for the number of plants (X_2) production input is 1.97 smaller than the t table value of 2.00, so that Ho is accepted, meaning that the use of production input for the number of plants is efficient. Whereas for the manure production input (X_3), the t count is 2.48 so it is greater than the t table value of 2.00, so Ho is rejected, meaning that the use of manure production input is not efficient. The use of manure is found to be inefficient, so it is recommended to increase the use of manure according to the Standard Operating Procedure (SOP) standards given both from the government and from the relevant agencies. The use of manure needs to be given more attention regarding the maturity of fertilizers to fulfill nutrients in plants.

4 Conclusions and Recommendations

Input factors that affect the production of honey pineapple are the number of plants, manure, and planting season. The number of plants has a positive effect on production, while manure has a negative effect on honey pineapple production as a result of immature manure. Meanwhile, the production of honey pineapple in the dry season is higher than the rainy season.

The use of manure and seed input is not allocatively efficient. Therefore, the two inputs need to be added optimally so that farming profits can be maximally increased. What is important to note is the use of manure that is ripe and of good quality so that it has a positive effect on the growth and production of honey pineapple.

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