EFFICIENCY ANALYSIS OF PRODUCTION FACTORS FOR PEOPLE'S SUGARCANE FARMING (*Sugarcane*) IN PUCAKWANGI DISTRICT PATI REGENCY

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ABSTRACT

Pucakwangi District is one of the sugarcane production centers in Pati Regency. The success of people's sugarcane farming production cannot be separated from the use of input production factors managed by the farmers themselves. The purpose of this study to know the effect of the use of production factors on sugarcane production and knowing the level of allocative efficiency in sugarcane farming. The method research used is quantitative research with a survey approach. Determination of the sample is done by purposive sampling. The number of sugarcane farmer respondents involved was 34 farmers. The effect of production factors on sugarcane production was analyzed using multiple linear regression with the Cobb-Douglas production function. Allocative efficiency through the comparison of the value of the marginal product with the price of the input. The results of the regression analysis show that partially the use of production factors that have a significant effect on people's sugar cane production are land area (X1), phonska fertilizer (X2), and ZA fertilizer (X3), meanwhile, the labor (X4) and herbicide (X5) factor has no significant effect on sugarcane production (Y). Simultaneously, the variables land area (X1), phonska fertilizer (X2), ZA fertilizer (X3), labor (X4), and herbicides (X5), have a significant effect on sugar cane production (Y). Allocative efficiency of the use of production factors which include land area (X1), phonska fertilizer (X2), and ZA fertilizer (X3) are not yet efficient, because > 1 so it is necessary to addition the use of production factors.

Keywords*: Production Factors, Efficiency, Sugarcane Farming, People*

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INTRODUCTION

Indonesia is known as an agricultural country, meaning agriculture plays a vital role in the entire national economy. Agricultural development is an integral part of national development, with 29.36% of the population employed in the agricultural sector (BPS, 2023). One agricultural sub-sector that is highly suitable and potentially suitable for development is the plantation sub-sector.

Sugarcane is a strategic plantation commodity in Indonesia that plays a significant role in the national economy. Sugarcane is widely grown in Indonesia by smallholder farmers, either independently or in partnership with sugar factories.*Sugarcane*) is a plant grown as a raw material for sugar production. Sugar is also a staple food for most people and a relatively inexpensive source of calories. Properly conducted sugarcane farming activities will certainly increase sugar production and increase farmer income. This success can be achieved if the management of production factors is utilized optimally (Ivanka*et al.*., 2019).

Indonesia is a sugar cane production center with a large sugar cane planting area to support national sugar cane production.Sugarcane-producing regions in Indonesia are divided into Java and the outer islands. The Indonesian provinces that contributed the most production during 2020-2022 were East Java and Central Java. Based on data The Directorate General of Plantations (2022) shows the area and production of sugarcane from smallholder plantations by province in Indonesia from 2020 to 2022. Central Java Province had the second-largest national sugarcane plantation area. The average planted area in Central Java Province during that period was 36,559 hectares, with an average sugarcane production of 152,800 tons. Pati Regency is a regency in Central Java Province, where the majority of its population relies on the plantation subsector. Sugarcane is one of the most widely cultivated crops in Pati Regency. Sugarcane is an easy-to-cultivate agricultural commodity. Based on the planted area and sugarcane production in Pati Regency in 2022, Pati Regency was the regency with the second-largest planted area and

production. In 2022,The sugarcane planting area in Pati Regency is 8,491.00 ha with sugarcane production of 540,375.86 tons. (BPS, 2023).

Pucakwangi District is one of the sugarcane production centers in Pati Regency. In 2021, Pucakwangi District had a planted area of 652.74 ha (BPS, 2023). In 2022, Pucakwangi District had two villages as sugarcane production centers with the largest sugarcane plantations in Pucakwangi District. The areas with the largest sugarcane plantations, respectively, were Pucakwangi Village and Terteg Village. Based on data from the Pucakwangi District BPP (2023), the village with the largest land area was Pucakwangi Village with 240 ha, and the second largest was Terteg Village with 54 ha.

The success of smallholder sugarcane farming is inextricably linked to the use of input factors of production managed by the farmers themselves. These input factors include land area, Phonska fertilizer, ZA fertilizer, labor, and herbicides.Efforts to develop sugarcane farming are still hampered by land availability and also by technical aspects of farming cultivation (Susilowati, 2012). This research aims to analyze the influence of production factors on smallholder sugarcane farming, as well as to determine the level of allocative efficiency of the use of production factors so that the resulting production can be optimal.

RESEARCH METHODS

The basic method used in this research is the quantitative method. The determination of the research location was determined by*purposive.* The study was conducted in Pucakwangi Village and Terteg Village, Pucakwangi District, Pati Regency. The sample included 34 smallholder sugarcane farmers out of a total population of 110. Sampling was conducted using a random sampling technique.*Purposive Sampling*with the criteria of being a smallholder sugarcane farmer (RC), having their own sugarcane land and self-managed bengkok land, the

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research location is smallholder sugarcane farmers in Pucakwangi Village and Terteg Village, and having a minimum sugarcane farming area of 0.5 hectares.

The data analysis used was multiple linear regression analysis with the Cobb-Douglas model production function. According to Soekartawi (2003), the production function*Cobb-Douglas*can be written as follows:

$$Y = a\ X_1^{b_1}\ X_2^{b_2}\ X_3^{b_3}\ X_4^{b_4} X_5^{b_5} \text{and}^{in}$$

To find out the coefficient of each change and to see whether each change influences the dependent change, a model in the form of a natural logarithm is used to produce:

$$\text{Ln } Y = \text{Ln } a + b_1 \text{ Ln } X_1 + b_2 \text{ Ln } X_2 + b_3 \text{ Ln } X_3 + b_4 \text{ Ln } X_4 + b_5 \text{ Ln } X_5 + \text{and}$$

Information :

Ln	= Natural logarithm
b1,b2.	= Regression coefficient
.	
A	= Constant
AND	= Sugarcane Production (kw)
X1	= Land Area (ha)
X2	= Phonska Fertilizer (kg)
X3	= Fertilizer ZA (kg)
X4	= Labor (HOK)
X5	= Herbicide (liters)
And	= *error train*

According to Soekartawi (2003), efficiency is the effort to achieve maximum production with the least amount of input. Price efficiency is achieved when the ratio between marginal productivity (NPMx) and input costs (Px) is equal. Mathematically, this can be written as follows:

$$\text{NPMx} = \text{Px or} \frac{NPMx}{Px} = 1$$

$$\frac{bx.Y.Py}{x} = \text{Px or} \frac{bx.Y.Py}{x.Px}$$

Where :

NPM	= Marginal product value
b	= Elasticity
AND	= Production
Py	= Production price Y

X = Number of production factors X
Px = Price of production input X

With the following conditions (Soekartawi, 2003):
When $\frac{NPM_x}{P_x}$ = 1 use of input X is efficient
When $\frac{NPM_x}{P_x}$ > 1 use of input X is not yet efficient (needs to be increased)
When $\frac{NPM_x}{P_x}$ < 1 The use of input X is inefficient (needs to be reduced)

RESULTS AND DISCUSSION

The sugarcane farmers who were respondents in this study consisted of various age groups, education levels, and experience in sugarcane farming. The characteristics of smallholder sugarcane farmers in Pucakwangi District, Pati Regency, showed that the largest age group was farmers aged 41-50 years, namely 11 people with a percentage of 32%. The age of farmers greatly influences sugarcane production, because at that age, farmers already have good experience, are able to solve problems in farming, and still have strong physical abilities to carry out sugarcane farming activities, thus increasing production results.

Sugarcane farmers based on education level showed that the majority of respondents were high school graduates, namely 17 people (50%). This indicates that farmers' education level influences their ability to accept and apply technology in sugarcane farming. Respondent characteristics based on the length of time engaged in farming showed that farmers who have been engaged in sugarcane farming for more than 10 years numbered 23 people (68%). This indicates that farmers' experience influences their abilities, skills, intelligence, and decision-making in carrying out sugarcane farming.

Ratoon sugarcane, or keprasan sugarcane, in the research area generally survives for an average of five years, depending on soil fertility. Keprasan sugarcane farming is considered easier to maintain than other agricultural

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commodities. This is highly favored by sugarcane farmers, as it also helps maintain the land's fertility.

Factors Influencing Sugarcane Farming Production

Multiple linear regression analysis with production function model*Cobb-Douglas*used to determine the effect of land area (X1), phonska fertilizer (X2), ZA fertilizer (X3), labor (X4), and herbicide (X5) on smallholder sugarcane production in Pucakwangi District, Pati Regency. Based on the results of data processing using SPSS 16.0, the following Natural Logarithm (Ln) model was obtained:

Table 1. Results of Multiple Linear Regression Analysis of Factors Influencing Sugarcane Production

Variables	Regression Coefficients	t-Count	Say.
Permanent	3,044	6,135	0,000
Land area (Ln_X1)	0,338	4,202	0,000
Phonska Fertilizer (Ln_X2)	0,190	2,725	0,011
Pupuk ZA (Ln_X3)	0,320	3,765	0,001
Labor (Ln_X4)	0,027	0,591	0,559
Herbicide (Ln_X5)	0,040	0,569	0,574
R Square = 0,978			
F Count = 245.736 (Say 0.000)			
Confidence level 95% (α = 0.05)			

Source: Primary Data Analysis (2024)

Based on Table 1, it can be seen that the results of the regression coefficients, then the equation of the multiple linear regression analysis model with the function*Cobb-Douglas*as follows:

LnY = 3.044 + 0.338Ln X1 + 0.190Ln X2 + 0.320Ln X3 + 0.027Ln X4 + 0.040Ln X5

Based on Table 1, it can be identified that the value of the coefficient of determination or*R Squared* (R^2) of 0.978, which means 97.8%. Sugarcane production is influenced by production factors in the form of land area (X1), phonska fertilizer (X2), ZA fertilizer (X3), labor (X4), and herbicides (X5), the remaining 2.2% is influenced by other variables that also influence sugarcane

production that are not included in the model. According to the results of Setiarini's research*et al.*(2021) explained that the Adjusted R Square value was 0.908, meaning that 90.8% of the sugarcane production variable was explained by land, Phonska fertilizer, ZA fertilizer, and labor. The remaining 9.2% was influenced by factors outside the model.

The results of the F-statistic test of the regression model show that the significance level value is 0.000 < 0.050. So in this case Ho is rejected and Ha is accepted, meaning that the variables of land area (X1), phonska fertilizer (X2), ZA fertilizer (X3), labor (X4), and herbicide (X5), indicate that the five independent variables simultaneously or together have a significant effect on the dependent variable, namely sugar cane production (Y).

The results of the t-statistic test, partially the use of production factors that have a significant influence on people's sugar cane production are land area (X1), phonska fertilizer (X2), and ZA fertilizer (X3), while labor factors (X4) and herbicides (X5) have no significant influence on sugar cane production (Y).

The land area variable (X1) has a significance value of 0.000 < 0.050. Therefore, Ho is rejected and Ha is accepted, meaning that the land area variable has a significant effect on sugarcane production. This is in accordance with Setiarini's research.*et al.*,(2021) explains that land has a significant influence on sugar cane production.

The phonska fertilizer variable (X2) has a significant value of 0.011 < 0.050. So in this case Ho is rejected and Ha is accepted. So in this case Ho is rejected and Ha is accepted.This means that the Phonska fertilizer variable has a significant effect on sugar cane production.This is not in accordance with what Ivanka's research suggests.*et al.*,(2019) explained that partially the phonska fertilizer factor did not have a real influence on sugarcane production.

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The ZA fertilizer variable (X3) has a significant value of 0.001 < 0.050. So in this case, Ho is rejected and Ha is accepted.It meansThe ZA fertilizer variable significantly impacts sugarcane production. This contradicts the research of Fathikin and Sudjoni (2020), who explained that the ZA fertilizer production factor has no effect on sugarcane production because ZA fertilizer itself is intended to supply sulfur nutrients to soils that are deficient in sulfur.

The labor variable (X4) has a significant value of0,559 > 0.050. So in this case Ho is accepted and Ha is rejected.This means that the labor variable has no significant effect on the amount of sugar cane production.This is in accordance with what was stated by Anggraningrum's research.*et al.*., (2022) explained that the labor production factor does not have a significant effect on sugar cane production.

The herbicide variable (X5) has a significant value of0,574 > 0,050. So in this case Ho is accepted and Ha is rejected.This means that the herbicide variable has no significant effect on sugarcane farming production.This is in accordance with what was stated by Astuti's research.*et al.*,(2021) explained that the herbicide production factor did not have a significant effect on sugarcane production according to the Kepras I criteria. This was because smallholder sugarcane farmers had used high doses.

Allocative Efficiency of Use of Production Factors in Sugarcane Farming

Input use is said to be allocative or price efficient if its marginal product (NPM) is equal to the price of the production input. The calculation used to analyze the allocative efficiency of production factors includes the regression coefficient values derived from the production function.*Cobb-Douglas*. Based on the results of the production function analysis*Cobb-Douglas*In the analysis of allocative efficiency of production factors, only variables that significantly influence sugarcane production are analyzed using the allocative efficiency formula. In this case, the factors with significant influences are land area, Phonska fertilizer, and ZA fertilizer. The results of the calculation of the allocative efficiency of sugarcane production factors can be seen in Table 2.

Table 2. Results of the Analysis of Allocative Efficiency of the Use of Production Factors in Sugarcane Farming

Variables	With a	Xi	Px	NPMx	NPMx/Px	information
Land area (ha)	0,338	1,76	7.985.294	17003470	2,1294	Not yet Ephesus
Phonska Fertilizer (kg)	0,19	776,68	3.212	21659,43	6,7433	Not yet Ephesus
Fertilizer ZA (kg)	0,32	1558,38	4.221	18180,68	4,3072	Not yet Ephesus
information : Y = 1196 Py = Rp. 74.000/ quintal						

Source: Primary Data Analysis (2024)

Based on Table 2, it can be seen that the ratio between the Marginal Product Value of land ($NPMx_1$) and the cost for land area (Px_1) is 2.1294. In this case, the value of the allocative efficiency of land area is more than 1, so it can be concluded that the use of land production factors is not yet efficient (NPMxi/Pxi> 1). The use of land production factors is not yet efficient. This is because farmers in the research area do not use land area optimally to obtain maximum production results, so it is necessary to add land area production factors or optimize the use of phonska fertilizer and ZA fertilizer production factors so that it can increase sugarcane production. This is not in line with Ivanka's research.*et al*.., (2021) explains that the use of land production factors is inefficient,This is because the land for sale is quite expensive.

The ratio between the Marginal Product Value of Phonska fertilizer ($NPMx_2$) and the cost of Phonska fertilizer (Px_2) is 6.7433. The allocative efficiency value of Phonska fertilizer obtained is more than 1, so the use of Phonska fertilizer production factors can be said to be inefficient (NPMxi/Pxi >1). The use of Phonska

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fertilizer is inefficient. This is because farmers in the research area use Phonska fertilizer that does not match the needs of sugarcane plants, so to optimize sugarcane production, the production factor of Phonska fertilizer needs to be increased. This is in line with Setriani's research.*et al.*., (2021) explained that the use of Phonska fertilizer has not reached the point of efficiency, because farmers do not use fertilizer according to recommendations.

The ratio between the Marginal Product Value of ZA fertilizer ($NPMx_3$) and the cost for ZA fertilizer (Px_3) is 4.3072. The allocative efficiency value of ZA fertilizer is more than 1, so the use of ZA fertilizer production factors can be said to be inefficient (NPMxi/Pxi >1). The use of ZA fertilizer production factors is not yet efficient. This is because farmers in the research area have not used ZA fertilizer.ZA fertilizer is not used optimally and is not used on time, so in this case, it is necessary to increase the use of ZA fertilizer by paying attention to the right dosage and timing to increase sugarcane production in Pucakwangi District, Pati Regency. This is in line with Anggrainingrum's research.*et al.*, (2022) explained that the ZA fertilizer production factor has not achieved allocative efficiency. The use of 61,870 kg/hectare of ZA fertilizer has not been optimally utilized to increase production, therefore, there is a need for additional use of ZA fertilizer.

CONCLUSION

Based on the research that has been conducted with the title of the thesis "Analysis of the Efficiency of Sugarcane Farming Production Factors (*Sugarcane*) The people in Pucakwangi District, Pati Regency" can be concluded that:

1. Partially, the use of production factors that have a significant effect on sugarcane production are land area (X1), phonska fertilizer (X2), and ZA fertilizer (X3), while labor factors (X4) and herbicides (X5) have no significant effect on sugarcane production (Y). Simultaneously, the variables of land area (X1), phonska fertilizer (X2), ZA fertilizer (X3), labor (X4), and herbicides (X5) have a significant effect on sugarcane production (Y).

2. The allocative efficiency of the use of production factors including land area (X1), phonska fertilizer (X2), and ZA fertilizer (X3) is not yet efficient, because it is > 1, so it is necessary to increase the use of production factors.

References

Anggrainingrum, A., A, Edy Prasetyo, & Wiludjeng Roessali. (2022). Analisis Efisiensi Faktor-Faktor Produksi Pada Usahatani Tebu Di Kecamatan Kayen Kabupaten Pati. *Jurnal Ekonomi Pertanian dan Agribisnis* (JEPA), 6(4), 1671-1683.

Astuti, T., N., Fembriarti, E., P., & Ktut, M. (2021). Efisiensi Teknis Usahatani Tebu Rakyat Dengan Pendekatan Stochasic Frontier di Kabupaten Lampung Utara. *Journal of Food System and Agribusiness*, 5(2), 156-165.

Balai Penyuluh Pertanian Kecamatan Pucakwangi. (2022). Data Luas Tanam Tebu 2022. Pati: Balai Penyuluh Pertanian Kecamatan Pucakwangi.

Badan Pusat Statistik. (2023). Booklet Sakernas Februari 2023. Jakarta: Badan Pusat Satistik. Pada https : //www.bps.go.id (diakses pada tanggal 13 Juli 2023).

Badan Pusat Statistik. (2023). Provinsi Jawa Tengah Dalam Angka 2023. Jakarta: Badan Pusat. Statistik Provinsi Jawa Tengah. Pada https:// https://jateng.bps.go.id/publication/2023/02/28/754e4785496c09ab1f787570/provinsi-jawa-tengah-dalam-angka-2023.html (diakses pada tanggal 15 Januari 2024).

Badan Pusat Statistik. (2023). Kabupaten Pati Dalam Angka 2023. Pati: Badan Pusat Statistik Kabupaten Pati. Pada https://patikab.bps.go.id (diakses pada tanggal 15 Januari 2024).

Direktorat Jendral Perkebunan. (2022). *Statistik Perkebunan Unggulan Nasional 2020-2022*. Jakarta: Sekertariat Direktorat Perkebunan - Kementrian Pertanian. Pada https://ditjenbun.pertanian.go.id (diakses pada tanggal 25 Desember 2023).

Fatikhin, M., & Nurhadi,S. (2020). Analisis Efisiensi Usahatani Serta Faktor-Faktor Yang Mempengaruhi Produksi Tebu Di Desa Badang Kecamatan Ngoro Kabupaten Jombang. *Jurnal Ketahanan Pangan*, 4(1), 10-16.

Ivanka D, M, Minar Ferichani, & Susi W,A. (2019). Analisis Efisiensi Penggunaan Faktor-Faktor Produksi Usahatani Oleh Petani Tebu Di Kecamatan Karanganyar Kabupaten Karanganyar. *Agrista*, 7(1), 55-61.

Setiarini, E., Sri, M., Shofia, N. A., & Dewi, H. (2021). Faktor yang Berpengaruh Terhadap Produksi Tebu di Kecamatan Pucakwangi Kabupaten Pati. *Proceedings Series on Physical & Formal Sciences*, *2*, 292–297. https://doi.org/10.30595/pspfs.v2i.203.

Soekartawi. (2003). Teori Ekonomi Produksi dengan Pokok Bahasan Analisis Fungsi Cobb-Douglas. Cetakan Ketiga. Jakarta: Rajawali Pers.

Susilowati, SH & Tinaprilla, N. (2012). Analisis Efisiensi Usahatani Tebu Di Jawa Timur. *Jurnal Littrivol* 18(4).