ANALYSIS OF TECHNICAL AND ECONOMIC EFFICIENCY OF THE USE OF PRODUCTION FACTORS AT CABBAGE FARMING IN GETASAN DISTRICT SEMARANG REGENCY

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Abstract: *The research aims to analyze the effect of factors of production (land area, labor, seeds, fertilizer, pesticides) on cabbage production; analyze the scale of cabbage farming; analyze the level of technical efficiency of the use of cabbage farming production factors; and analyze the level of economic efficiency of cabbage farming in Getasan District, Semarang Regency. The study was conducted in February 2018 in Getasan Sub-District, Semarang Regency. The study was conducted using survey methods and sample determination using the multistage random sampling method. The number of samples was determined by the Slovin method and obtained a sample of 100 cabbage farmers. Data analysis was performed using the Cobb-Douglas model production function, production factor elasticity analysis, marginal product value analysis, marginal cost of production input. The results showed that the factors of production of land area, seeds, organic fertilizer, chemical fertilizers and liquid pesticides had a significant effect on cabbage production, while the factors of production of solid pesticides and labor did not significantly affect cabbage production. Farming scale is in the condition of increasing return to scale with an elasticity value of 1.113. Cabbage farming in Getasan District is not yet technically efficient with an average efficiency of 86.8%. The use of land production factors, seeds, organic fertilizers, chemical fertilizers, and liquid pesticides has not been economically efficient. The use of factors of production of solid pesticides and labor is not economically efficient.*

Keywords: *Cabbage, Factors of Production, and Efficiency*

I. INTRODUCTION

Cabbage is one of the main horticultural commodities in Central Java. Semarang Regency is a cabbage producer in Central Java and its production centers are in Getasan District. The harvest size of cabbage harvest in Kecamatan Getasan in 2016 was 980 hectares or had a proportion of 76% of the total area of cabbage in Semarang Regency with a total production of 163,006 quintals (BPS Semarang Regency, 2017).

Cultivation technique culture that is carried out by cabbage farmers in Getasan District is still based on experience and planting habits, so that it has not applied cultivation techniques in accordance with the recommendations or operational standards, including the use of aquaculture inputs. This is reinforced through the opinion of Rafika (2015) which revealed that experience is the basis of guidance for farmers in carrying out farming activities, especially in conditions of limited resources. Decisions on the use of inputs including seeds, fertilizers, and pesticides are also influenced by the behavior of farmers in dealing with risks as stated by Pujiharto and Wahyuni (2017). Farming risks include uncertainty about the level of input prices of agricultural output, disease, and climate (Hasan et al., 2018).

The diversity of farmers' behavior in facing farming risk and the not yet applying the cultivation reference standard causes the diversity of decisions in the use of farming inputs. The use of farming inputs that are not yet efficient causes farmers to not be able to achieve maximum income. It is necessary to study to determine the standard for the use of cabbage farming production input in order to obtain maximum income. The use of production inputs in cabbage farming is a sacrifice whose value must be calculated to be issued by farmers. The more amount of production input used will increase the amount of sacrifice costs so that it affects the level of profit of farmers. An assessment of the level of economic efficiency is needed primarily on the condition of the diversity of input allocations and the risk of uncertainty in input and output prices. The economic efficiency study looks at the proportion of marginal production value at the level of the price of production input costs incurred by farmers to obtain maximum income.

This study aims to analyze the effect of factors of production (land area, labor, seeds, fertilizer, pesticides) on cabbage production; analyze the scale of cabbage farming; analyze the level of technical efficiency of farming production factors cabbage; and analyzing the economic efficiency of the use of cabbage farming production factors in Getasan District, Semarang Regency.

II. RESEARCH METHODS

The study was conducted in Getasan Subdistrict, Semarang Regency during the cabbage harvest season in February 2018. The research location was determined purposively in Getasan Subdistrict, with consideration as an area with the largest harvested area and cabbage production in Semarang Regency.

Research using survey methods. Determination of the sample by multistage random sampling method. The number of samples determined by the Slovin method were 100 respondents of cabbage farmers and were taken from 4 villages producing cabbage centers in Getasan Subdistrict namely: Tajuk, Batur, Kopeng, and Wates. Analysis to determine the factors of production that affect cabbage production using the Cobb Douglas production function model.

$$Y = \beta_0 X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3} X_4^{\beta 4} X_5^{\beta 5} X_6^{\beta 6} X_7^{\beta 7} X_n^{\beta n} e^u$$

Y : production result

B_n : the elasticity of each factor of production (β_1, β_2, β_3)

X_n : factor of production (X_1, X_2, X_3)

e : natural logarithm (2,1782…)

u : error

The transformation into the Cobb Douglass model production function starts with the form of multiple linear regression through natural logarithms as follows:

$$\ln Y = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + u$$

Y : production result (kg / m),

X_1 : land area (m^2),

X2 : number of seeds (stems / m),

X3 : the amount of organic fertilizer (kg / m),

X4 : the amount of chemical fertilizer (kg / m),

X5 : the amount of solid pesticides (gr / m),

X6 : the amount of liquid pesticides (ml / m),

X7 : the amount of labor (HOK / m),

A : *intercepts*,

β : coefficient,

u : error

F test was carried out to determine the simultaneous influence of variable land area, number of seeds, amount of chemical fertilizer, amount of organic fertilizer, amount of solid pesticides, amount of liquid pesticides, amount of labor used on variable amount of cabbage production. F test results are determined by accepting or rejecting the initial hypothesis (H0). The initial hypothesis (H0) is that there is no simultaneous influence of independent variables on cabbage production. The initial hypothesis (H0) is accepted if the calculated F value < F table value or sig value > 0.05. The alternative hypothesis (H1) is that the independent variables simultaneously influence the cabbage production variable. An alternative hypothesis is accepted if the calculated F value > table F value or sig < 0.05.

T test was conducted to determine the effect of variable land area, number of seeds, amount of chemical fertilizers, amount of organic fertilizer, amount of solid pesticides, amount of liquid pesticides, the amount of labor used individually to the variable amount of cabbage production. T test is done by comparing the value of t arithmetic and t table. The initial hypothesis (H0) is that each independent variable does not affect the cabbage production variable. The initial hypothesis (H0) is accepted if the calculated t value < t table value. The alternative hypothesis (H1) is that each independent variable significantly influences cabbage production. Alternative hypotheses are accepted if the calculated t value > t table value.

The coefficient of determination (R2) is performed to determine the accuracy of the regression equation model to explain the conditions in the field. The coefficient of determination is expressed as a percentage of the dependent variable influenced by the independent variables in the regression equation model. The model is considered good if the coefficient of determination (R2) is equal to one or close to one (Gujarati, 1997). The scale of business in cabbage farming is known from the sum of the production coefficients (β1, β2, ..., βn) in the Cobb-Douglas production model function (Soekartawi, 2002). The addition of the production coefficient produces three possibilities, namely: (1) $\sum\beta < 1$ which means the proportion of the addition of production factors will produce additional production with smaller proportions or the condition of decreasing return to scale, (2) $\sum\beta = 1$ which means the addition of proportional production factors with the addition of production or the condition of constant return to scale (3) $\sum\beta > 1$ the proportion of the addition of production factors will produce additional production with a greater proportion or the condition of increasing return to scale.

Analysis of technical efficiency is known through the value of the elasticity of each input in the regression equation of the Cobb-Douglas production function model. Shinta (2011) said that technical efficiency testing was carried out by calculating the known elasticity of production from the regression coefficients. The program used to conduct analysis is Frontier 4.1.

The value of production elasticity (EP) is the same as the regression coefficient, so if the EP value ranges from 0 to 1 then the use of production factors is efficient. EP value < 0 indicates that the use of production factors is inefficient, so it needs to be reduced. EP value > 1 indicates that the use of production factors has not been efficient. The technical efficiency of each respondent can be seen in the output of the Frontier 4.1 program. The analysis results obtained from the Frontier 4.1 program were further analyzed using one sample t test analysis to compare the average value of technical efficiency with a value of technical efficiency of one. The initial hypothesis (H0) is accepted if the significance value obtained > 0.05 so that it is concluded that the efficiency value of cabbage farming in Getasan District is equal to one which means it has reached technical efficiency. The alternative hypothesis (H1) is accepted if the significance value obtained is < 0.05 which can be concluded that the efficiency value of cabbage farming in Getasan District is not the same as one which means that it has not or has not yet reached technical efficiency.The use of production factors will reach optimal conditions when the marginal product value is equal to the cost sacrificed to obtain inputs. Formulated with:

$$NPMx_i = Px_i \quad \text{atau} \quad \frac{NPMx_i}{Px} = 1$$

NPMx and Px ratios greater than one mean that the use of production factors is economically inefficient. An NPMx and Px ratio of less than one means that the use of production factors is economically inefficient. One sample t test is done by comparing the value of economic efficiency of each factor of production against the value of economic efficiency equal to one. H0 is accepted if the significance value obtained> 0.05 concludes that the economic efficiency value is equal to one or the use of production factors is economically optimal. H1 is accepted if the significance value <0.05 concluded that the value of economic efficiency is not the same as one which means the use of production factors is not or not yet economically optimal.

III. RESULTS AND DISCUSSION

3.1 Characteristics of Respondents

Characteristics of respondents provide an overview of respondents related to farm management. Respondent characteristics in this study include the age of the farmer, the length of formal education, the number of family dependents and the length of farming experience.

Table 1. Characteristics of Cabbage Farmers (Respondents) in Getasan District, Semarang Regency

No	Description	Average
1	Age of farmer (years)	44,75
2	Length of formal education (years)	7,52
3	Number of family dependents (peoples)	5,00
4	Length of farming experience (years)	19,40

The age of the respondent can be related to the physical ability of the respondent to run the farm. The average age of respondents is 44.75 years, including very productive so that physically they are still able to manage cabbage farming. The average respondent has 7.52 years of education or is equivalent to not completing junior high. The level of education is very influential in the absorption of knowledge or technology adoption. Low education level will hamper the process of technology adoption (Soekartawi, 2006). Suharyanto, et al. (2015) states that the higher education will improve technical efficiency.

The average dependents of respondent family members are 5 people. Family members can support the implementation of farming as a workforce. The use of family members as labor will reduce the cost of outside labor that must be paid by farmers. The average length of experience of respondent farming was 19.4 years. Farming experience is a capital for farmers in trying to farm, as Scott's opinion in Rafika (2015) states that in conditions of limited resources will encourage farmers to choose to run their farming with the lowest risk according to farming experience.

3.2 Analysis of Factors Affecting Cabbage Production

Testing the production function data variable is needed to get the ordinary least square (OLS) estimation method that will produce an unbiased value or BLUE (Best Linear Unlimited Estimator). The test results show that (1) data are normally distributed based on normality testing using the Kolmogorov Smirnov method with a significance level of 0.453 or greater than 0.05 (2) multicollinearity does not occur with the tolerance value of each independent variable more than 0.1 and the VIF value less than 10 so it can be concluded that there is no correlation between independent variables (3) there is no heteroscedasticity as seen from the pattern of error distribution on scatterplot charts and the significance value of the Glejser test results of each production factor is more than 0.005.

The model of multiple linear regression equations in the form of natural logarithms is produced as follows:

$$Ln\,Y = 0{,}565 + 0{,}187\,Ln\,X_1 + 0{,}512\,Ln\,X_2 + 0{,}198\,Ln\,X_3 + 0{,}133\,Ln\,X_4 - 0{,}021\,Ln\,X_5 + 0{,}158\,Ln\,X_6 - 0{,}054\,Ln\,X_7 + u$$

The equation is estimated in the form of a linear equation, so to convert it back to a non-linear equation the antilogarithm is performed so that the Cobb Douglas model equation is:

$$Y = 1{,}76\,X_1^{0{,}187}X_2^{0{,}512}X_3^{0{,}198}X_4^{0{,}133}X_5^{-0{,}021}X_6^{0{,}158}X_7^{-0{,}054}$$

The F test is used to determine the effect of the independent variables simultaneously or together on the dependent variable. The test results using SPSS show that the significance value of 0,000 or smaller than 0.05. The calculated F value of 44.841 is greater than the F table of 2.109 at a significance level of 5 percent or 0.05 so it is concluded that H0 is rejected and H1 is accepted, which means that the variable area of land, seeds, organic fertilizers, chemical fertilizers, solid pesticides, liquid pesticides and labor simultaneously have a significant effect on cabbage production in Getasan District.

Table 2. T Test Results The Effect of Each Production Factor on Cabbage Production in Getasan District, Semarang Regency

Input Variable	Coefficient	Standard Error	t-ratio	
Constanta	1,760	0,509	1,109	
Land area (X_1)	0,187	0,094	1,987	*
Seed (X_2)	0,512	0,088	5,795	**
Organic fertilizer (X_3)	0,198	0,057	3,504	**
Chemical Fertilizer (X_4)	0,133	0,058	2,285	*
Solid Pesticides (X_5)	-0,021	0,031	-0,666	ns
Liquid Pesticides (X_6)	0,158	0,034	4,723	**
Labor (X_7)	-0,054	0,089	-0,602	ns
R^2	0,773			
γ	0,350	0,741	0,472	

Information: ** Significantly influences the 99% confidence level or t table = 2,367,
* Significantly influence the 95% confidence level or t table = 1,661,
ns no real effect

The results of the analysis in Table 2 show that the variable seeds, organic fertilizer, liquid pesticides have a significant effect on cabbage production at a 99 percent confidence level. Variable land area and chemical fertilizer significantly influence the level of cabbage production at a 95 percent confidence level. Variable solid pesticides and labor did not significantly affect cabbage production. These results are consistent with Hidayati's research (2018) which states that land, organic fertilizer and chemical pesticides have a significant effect on cabbage production. Abdulrahman et al., (2018) and Ningsih (2016) state that land area significantly influences cabbage production. Malinga et al., (2015) which states that chemical seeds and fertilizers affect cabbage production. Akamin et al. (2017) that the use of organic fertilizers, land area and chemical fertilizers has a significant effect on vegetable production. Satriajaya et al., (2019) which states that urea pesticides and fertilizers have a significant effect on cabbage production.

Observation at the research location shows that the spacing used by farmers is not uniform due to different land slopes. An increase in land area will increase the population of the number of plants per area of land management, thus increasing the amount of production. The average seed use of each farmer is 1,812 stems on an area of 1000 square meters so that it is still less than the recommended use of cabbage seeds according to Balitsa (2007) of 4,000 stems per 1000 square meters. The planting system prevailing in Getasan is an intercropping system with a short planting time interval so that the soil is quickly drained of its organic material content. Hartatik et al. (2015) states that organic fertilizer is useful for improving soil structure, improving soil pore size distribution, and reducing soil temperature fluctuations. The addition of the use of organic fertilizers will improve the quality of plant growth, so that the resulting production will increase.

Labor and solid pesticides are factors of production that have no significant effect on cabbage production. The results of this study are in line with research by Wahyuningsih (2018) and Ningsih (2016) which states that the use of excessive labor and inappropriate harvesting methods will reduce the amount of production due to crop damage and the potential for scattered yields. R^2 value of 0.773 which means that the variation of the independent variables included in the equation model can explain the variation of the dependent variable by 77.3 percent. 22.7 percent of the variation of the dependent variable is explained by other variables not included in the equation model. The value of the Stochastic Frontier production function of this model is 0.35, which means that 35 percent of the errors in the production function are due to technical inefficiencies and the remaining 65 percent are due to random variables that cannot be controlled by farmers. Random variables can be in the form of weather, climate, soil fertility. Anggraini et al (2016) states that random variables that cannot be controlled in cultivation such as: pests, diseases, land fertility, temperature and climate.

3.3 Farm Business Scale Analysis

Scale of effort in cabbage farming is known from the amount of elasticity (β1, β2, ..., βn) in the Cobb-douglas production function model. The scale of farming in this study is known by adding up the amount of elasticity of each of the suspected production factors. The amount of elasticity in table 1 is added up so that the total value of the elasticity coefficient is 1.113. The total value of the elasticity coefficient of 1.113 or greater than 1 means that the scale of cabbage farming in Getasan District is in the condition of increasing return to scale. Business scale greater than one shows that the addition of input of production factors can still provide an increase in the amount of production with a greater proportion.

The condition of increasing returns to scale shows that the value of marginal product is greater than the average product (Karim, 2007). Farmers can increase the use of inputs to get additional production to reach the peak of total production. After the peak of total production which is the optimal point of input use is reached, if the farmer adds production inputs it will reduce the total production obtained, so that in this condition the use of production inputs should be reduced.

3.4 Analysis of Technical Efficiency of Production Factors

The results of the analysis in Table 1 show that the elasticity value of land production, seeds, organic fertilizers, chemical fertilizers, and liquid pesticides is greater than zero and smaller than one which shows that the use of land production factors, seeds, organic fertilizers, chemical fertilizers, and pesticides liquid has been at a rational stage or achieved technical efficiency. The Value of Production Elasticity (EP) of land production factors, seeds, organic fertilizers, chemical fertilizers, and liquid pesticides is positive and smaller than one indicates that the Marginal Product (MP) value is smaller than the Average Product (AP) so that it is concluded that production activities are at decreasing return stage. Increasing the use of inputs can still increase the amount of production but with a proportion of increasing the amount of smaller production.

The regression coefficient value of the factor of production of solid pesticides and labor is smaller than zero which indicates that the use of factors of production of solid pesticides and labor is technically inefficient. The EP value of the factor of production of solid pesticides and labor is negative and is smaller than one, indicating that the Marginal Product (MP) value is smaller than the Average Product (AP) which means that increasing the use of input of solid pesticides and labor will reduce the amount of production. The value of technical efficiency of each respondent farmer is the ratio of production relative to maximum production (frontier) that can be achieved by farmers. Coelli et al. (1991) suggested that technical efficiency is the ratio of observational farming production to the production of the frontier production function.

Table 3. Description of the Technical Efficiency Achievement of Cabbage Farming in Each Resondent in Getasan District, Semarang Regency Based on the Frontier Production Function Model

No	Description	Achievement Value
1	Minimum technical efficiency	0,730
2	Maximum technical efficiency	0,940
3	Average technical efficiency	0,868

One sample t test was conducted by comparing the technical efficiency value of cabbage farming in Getasan District to the value of technical efficiency of 1. The significance value of the results of the one sample t test obtained was 0,000 or smaller than 0.05 so it was concluded the technical efficiency of cabbage farming was different markedly with a technical efficiency value of one at a 95 percent confidence level so that cabbage farming in Getasan District is not yet technically efficient.

3.5 Economic Efficiency Analysis of Production Factors

The use of optimal input is achieved if the value of the ratio of NPMx and Px is equal to one. The value of the ratio of NPMx to Px is shown in Table 4.

Table 4. Calculation of Economic Efficiency in the Use of Factors for Cabbage Farming Production

Production Factors	Xi	Bi	NPMxi	Pxi	NPMXi/ Pxi
Soil (m^2)	1.595,25	0,187	489,12	195,93	4,198
Seed (stem)	2.887,00	0,512	653,00	76,10	13,85
Organic fertilizer (kg)	2.584,15	0,198	361,62	267,15	1,52
Chemical Fertilizer (kg)	21,00	0,133	29.926,00	11.521,00	3,09
Solid Pesticides (g)	300,00	-0,021	-732,77	75.530,00	-1,30
Liquid Pesticides (ml)	569,00	0,158	1.923,00	435,00	4,63
Labor (HKP)	51,26	-0,054	-4.411,00	50.000,00	-0,09
Production (kg)	1.924,31				
Cabbage Prices (Rp)	2.056,98				

Information: Xi : Production factors
Bi : Production elasticity
NPMxi : Marginal product value of production factor
Pxi : Price of the production factors

The results of the one sample t test for the value of NPMxi / Pxi of each production input are in Table 5.

Table 5. Test Results of One Sample T Test of NPMxi / Pxi Ratio Value of Cabbage Farming to NPMxi / Pxi Ratio Value = 1

Production Factors	Average NPM_x/P_x	Average Std. Error	Significant	Conclusion
Soil	4,198	0,27411	0,000	BE
Seed	13,850	1,24509	0,000	BE
Organic fertilizer	1,520	0,08462	0,000	BE
Chemical Fertilizer	3,090	0,20017	0,000	BE
Solid Pesticides	-1,300	0,09441	0,000	TE
Liquid Pesticides	4,630	0,32785	0,000	BE
Labor	-0,088	0,00504	0,000	TE

The significance value of the results of the one sample t test for all factors of production obtained is 0,000 or smaller than 0.05 so it is concluded that the value efficiency of the factors of land production, seeds, organic fertilizer, chemical fertilizer, solid pesticides, liquid pesticides and labor is not equals one at a 95 percent confidence level. The value of NPMx1 and Px1 ratio of land production factors is 4.198 or greater than one, which means the use of land production factors is not economically efficient. The value of land input NPMx is still greater than the input price (Px) illustrating that there are still benefits from the use of land production factors. Adding land inputs can be made possible through new land leases. The results of this study are in line with research by Mandei and Tuwongkesong (2015) which states that the factors of land production, seeds, manure and NPK fertilizer have not been economically efficient so their use needs to be increased to achieve maximum profit.

The value of NPMx2 and Px2 ratio of seed production factors is 13.85 or greater than one which means the use of seed production factors is not economically efficient. NPMx value of seed input is still greater than the input price (Px) illustrates that there are still benefits from the use of seed production factors. Adding seed input can increase cabbage production so that farmers' income increases. The value of NPMx3 and Px3 ratio of organic fertilizer production factors is 1.52 or greater than one which means the use of organic fertilizer production factors is not economically efficient. NPMx value of organic fertilizer inputs is still greater than the input price (Px) illustrating that there are still benefits from the use of organic fertilizer production factors. Adding organic fertilizer inputs can increase cabbage production so that farmers' income increases.

The value of NPMx4 and Px4 ratio of chemical fertilizer production factors is 3.09 or greater than one which means the use of chemical fertilizer production factors is not economically efficient. NPMx value of chemical fertilizers is still greater than the input price (Px) illustrating that there are still benefits from the use of chemical fertilizer production factors. Chemical fertilizers are obtained by farmers at retail kiosks at less uniform prices. The use of fertilizer is very necessary, especially in the cultivation of sloping land given the faster erosion of land compared to planting on flat land. The addition of the use of chemical fertilizer inputs can increase cabbage production so that farmers' income increases.

The value of the ratio of NPMx5 and Px5 factors of production of solid pesticides is -1.30 or smaller than one which means the use of factors of production of solid pesticides is not economically efficient. NPMx value of input of solid pesticides is still smaller than the price of the input (Px) illustrating the use of solid pesticides has exceeded optimal. Observations at the study site showed that the use of solid pesticides by farmers was mainly in the form of fungicides, while the symptoms of fungal diseases were rarely encountered. Inappropriate use of pesticides will affect the effectiveness of these pesticides to control the target (Puslitbanghort, 2018).

The value of the ratio of NPMx6 and Px6 factors of production of liquid pesticides is 4.63 or greater than one which means the use of liquid pesticide production factors has not been economically efficient. The NPMx value of liquid pesticide input is still greater than the input price (Px) illustrating that there are still benefits from the use of liquid pesticide production factors. Liquid pesticides used by farmers in general are in the form of insecticides. Observations at the study site showed that the level of pest attacks was mostly caused by Plutella leaf worms. Farmers can increase the use of liquid pesticides but need to pay attention to the recommended dosage of use. Excessive use of pesticides will increase pest resistance and production costs as Puspitasari and Kiloes (2016) argue.

The value of NPMx7 and Px7 ratio of labor production factors is -0.088 or smaller than one which means the use of labor production factors is economically inefficient. The NPMx value of labor input is still smaller than the price of the input (Px) illustrating the use of labor has exceeded optimal. Labor costs for male casual daily laborers in general in the study area are Rp50.000,00 per HKP. The handling of harvest and post-harvest activities at the research location is generally carried out in a mutual cooperation involving families and the community. The use of labor that is too much will increase the costs to be paid by farmers. The use of inappropriate harvesting and postharvest methods also increases the potential for yield damage and decreases selling prices. It is necessary to reduce the use of labor inputs to reduce labor costs and to use the right postharvest harvest method in order to obtain optimal profit levels.

IV. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Cabbage production is significantly affected by land, seeds, organic fertilizer, chemical fertilizers, liquid pesticides, while the factors of solid pesticide production and labor do not significantly affect cabbage production. The scale of cabbage farming in Getasan Subdistrict is in the condition of increasing return to scale, indicating that the addition of production factor inputs can still increase the amount of production with a greater proportion. Farmers can increase the use of production inputs until the total production is achieved.

The use of land production factors, seeds, organic fertilizers, chemical fertilizers, and liquid pesticides have all been at a rational stage or achieved technical efficiency. The use of production factors for solid pesticides and labor is not technically efficient. The average technical efficiency value of cabbage farming in Getasan Subdistrict of 0.868 was significantly different from the technical efficiency value of one so that it was concluded that cabbage farming in Getasan District had not yet reached technical efficiency. The use of land production factors, seeds, organic fertilizers, chemical fertilizers, liquid pesticides has not been economically efficient. Farmers can increase the use of these production inputs to achieve maximum profits. The use of solid pesticide production factors and labor is not economically efficient, so its use should be reduced.

4.2 Recommendations

1. Planting in the planting lane is carried out at a spacing as recommended to increase the number of plants in each land area and increase the efficiency of land use given the difficulty of opening new land.
2. Applying the principle of integrated pest control (IPM) to support the control of cabbage plant pest attacks that are more targeted, right in number, right type, and right quality. The application of IPM principles will improve the efficiency of pest control of plant diseases.
3. Applying the principles of proper harvest and post-harvest to reduce the potential for damage to crops, especially related to the use of harvest methods and the use of appropriate harvesting and post-harvest facilities. Less damage to yields will increase the income received by farmers so that economic efficiency increases.

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