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TECHNICAL EFFICIENCY AND ECONOMIC ANALYSIS OF USAGE PRODUCTION FACTORS OF POTATO FARMING IN NGABLAK SUB-DISTRICT, MAGELANG REGENCY

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ABSTRACT

This research aims to analyze the effect of the use of production factors on the amount of potato production, as well as to analyze the technical and economic efficiency of the use of potato farming production factors in Ngablak District, Magelang Regency.thesurveymethodwasusedin this research. The research sample was determined byaimplerandom sampling method with the number of respondents as many as 75 potato farmers. The results showed that the production factor of land area, seeds, pesticides, and labor partially had a significant effect on potato farming production, while the production factors of organic fertilizer and phonska fertilizer had no significant effect on potato production in the study area. Potato farming in Ngablak District is not technically efficient with an average technical efficiency value of 0.72. The use of inputs for the production of land areas, seeds, organic fertilizers and pesticides has not yet achieved economic efficiency, while the use of inputs for the production of phonska fertilizer and labor is economically inefficient.

Keywords: *efficiency, factors of production, farming, potatoes*

BACKGROUND

The agricultural sector has an important role in social and economic development. The agricultural sub-sector consists of food crops, plantation crops, horticultural crops, forestry, fisheries and livestock. Agricultural development in an area certainly has the goal of increasing and meeting the food needs of the community, income and standard of living of farmers. Efficient development of the agricultural sector, namely being able to optimally utilize existing resources, maintain changes both technically and economically and be able to play a role in national development (Solahuddin, 2018).

The community's need for potatoes continues to increase in line with the increase in population and purchasing power. BPS data (2020) explains that the average per capita consumption of potatoes is increasing from year to year, namely in 2019 per capita consumption of potatoes reached 2,282 kg/cap/year and increased to 2,727 kg/cap/year in 2020. Consumption of The increase in potatoes must of course be balanced with an increase in the amount of production. Efforts that can be made to increase the production of a plant is through production efficiency. Management in the proper and efficient use of production factors can increase production and maintain the sustainability of the farming business (Sukayat et al., 2019).

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Ngablak District is a potato producing area in Magelang Regency which has a harvest area of 125 ha and productivity reaching 17 tonnes/ha. The advantage of Ngablak District is that it has an altitude of 1,378 meters above sea level, an area with an altitude of around 1,000-1,300 meters above sea level is an ideal area for potato cultivation. However, in reality Ngablak District has not been able to produce potatoes optimally. This can be seen from the potato production which is still lagging behind the Kajoran District, which, when viewed from the elevation of the area, Kajoran District has an area with an altitude of only 578 meters above sea level and its potato productivity can reach 26.70 tons/ha with a harvest area of 105 ha (BPS, 2021).

Obstacles that are often faced by farmers in farming potatoes, namely cultivation techniques and pest attacks, this causes a decrease in potato productivity in Ngablak District. The use of seeds, fertilization and the application of pesticides that are not in the right dosage and at the right time are also obstacles for farmers in running their farming (Vegetables Research Center, 2016). The use of production inputs in this case plays an important role to increase production. The use of production inputs is inaccurate both in quantity and combination, so this affects production and costs incurred (Maryanto et al., 2018). Farmers in this case are required to be able to use production factors that are owned efficiently in the management of their farming.

RESEARCH METHODS

The method used in this research is a survey. Farmers who were used as respondents in this study were selected using the simple random sampling method of 75 farmers taken from 2 villages namely Madyogondo Village and Sumberejo Village. The influence of the production factors of potato farming was studied using the Cobb Douglas production function model. The production function of the Cobb Douglas model used is written in the following equation:

$$\text{Ln } Y = \ln a + b1\ln X1 + b2\ln X2 + b3\ln X3 + b4\ln X4 + b5\ln X5 + b6\ln X6 + e$$

Information:

Y : Potato Production (kg/ha)
α : Constant
b1-b6 : Regression Coefficient
X1 : Land Area (ha)
X2 : Seeds (kg)
X3 : Organic Fertilizer (kg)
X4 : Phonska Fertilizer (kg)
X5 : Pesticide (liters)
X6 : Labor (HKP)
e : Error/error

Measurement of technical efficiency achieved by farmers in the study area is measured by comparing actual production (Yi) with potential production (Yii) formulated by (Soekarwati, 2003) as follows:

$$\text{ET} = \frac{Y_i}{Y_{ii}}$$

Information:

ET : Level of technical efficiency

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Yi : The amount of production (output) to – i
Yii : The amount of production estimated at the ith observation is obtained through the Cobb Douglas frontier production function. The program used to perform technical efficiency analysis is Frontier 4.1.

The ET (technical efficiency) value varies between 0 and 1 oru $0 \leq TE \leq 1$.ET = 1, then the use of inputs is said to be efficient and the farmers are technically efficient. (Saptana, 2012). The results of the Frontier program analysis were then tested using the one sample t test (One Sample T Test) by comparing the average value of technical efficiency with the technical efficiency value of one (test value = 1). The criteria for testing the One Sample T test are as follows (Nuryadi et al., 2017):

1. H0 is rejected and H1 is accepted, if the significance value is <0.05 or t count > t table, it means that the use of production factors for potato farming in the study area is not technically efficient
2. H0 is accepted and H1 is rejected, if the significance value is > 0.05 or tcount <ttable, it means that the use of farming production factors in the study area is technically efficient

Economic efficiency can be achieved if the ratio between the marginal production value (NPMx) is the same as the input price (Px), can be tested with the following formula:

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

$$\frac{b.Y.Py}{x} = Px \text{ or } \frac{b.Y.Py}{X.Px} = 1$$

Information:
NPMx : Scoremarginal production
Px : Price of factor of production X (Rp)
Py : Price factor of production Y (Rp)
b : Elasticity
x : The number of factors of production x
Y : Production (kg)
i : Production factor

The decision making used is as follows (Maharani, 2019):

$\frac{NPMxi}{Pxi} > 1$, meaning that the use of production factors is not efficient so that input x needs to be added.
$\frac{NPMxi}{Pxi} = 1$, meaning the use of factors of production efficiency.
$\frac{NPMxi}{Pxi} < 1$, meaning that the use of production factors is not efficient so that input x needs to be reduced.

The One Sample T test is carried out by comparing the economic efficiency value of each production factor to the economic efficiency value equal to one (test value = 1), with the following testing criteria (Nuryadi et al., 2017):

1. H0 is accepted if the significance value is > 0.05, meaning that the value of economic efficiency is equal to one.
2. H1 is accepted if the significance value is <0.05, meaning that the value of economic efficiency is not equal to one.

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RESULT AND DISCUSSION

Characteristics of Respondent Farmers

The characteristics of respondents in a study describe the background and provide an overview of the diversity of respondents. The characteristics of the respondents in this study were based on age, recent education, land area, length of farming and land ownership. The characteristics of the respondents in the study area are presented in Table 1.

The age of the respondent farmers in the study area varied. The age group of 31-40 years ranks first with a total percentage of 32% of the total respondent farmers. The 20-30, 41-50, and 51-60 year age groups totaled 12, 23, and 13 people or 16%, 31%, and 17% of the total respondent farmers. Almost all of the respondent farmers in the study area had an elementary school education, with a total of 44 people or 59% of the total respondent farmers. Land area is the total area of land used by farmers to cultivate potatoes. The area of the respondent farmers' land in the study area was very diverse, ranging from 0.1 to 0.8 ha. The land area <0.3 ha has a high percentage, namely 61% of the total farmer respondents. The average area of land owned by farmers in the study area is 0.26. The duration of farming can affect the success of farming. The longer the farming run, the more experience the farmer has. The average experience of farming in the study area is 1-5 years with a percentage of 43% of the total number of respondent farmers.

Table 1. Characteristics of Respondents

No	Characteristics	Amount (person)	Percentage (%)
1	Age (Years)		
	20-30	12	16
	31-40	24	32
	41-50	23	31
	51-60	13	17
	>60	3	4
2	Last education		
	Elementary School	44	59
	Junior High School	22	29
	Senior High School	8	11
	Bachelor	1	1
3	Land Area (ha)		
	<0.3	46	61
	0.3-0.5	25	33
	>0.5	4	5
4	Long Trying		
	1-5	32	43
	6-10	30	40
	10-15	7	9
	16-20	2	3
	>21	4	5

Source: Primary Data, 2022

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The Influence of Production Factors on Potato Farming Production

Production factors were analyzed to determine whether there was an influence on potato production in Ngablak District, namely land area, seeds, phonska fertilizer, organic fertilizer, pesticides and labor. Based on the data in Table 2, it can be seen that the calculated F value = 34.249 and F table = 2.13 with a significance of 0.000 ≤ 0.05. These results show that the variables of land area, seeds, organic fertilizers, phonska fertilizers, pesticides and labor simultaneously have a significant effect on potato production in the study area.

Variable land area has a partially significant effect on potato production in Ngablak District. The resulting significance value is 0.020 (α ≤ 0.05) and t count = 2.083 > t table = 1.999. Land area production input has a considerable influence on production. Research results of Agatha and Wulandari (2018) as well asAmbarita and Kartika (2015) explain that the wider the land used in farming, there tends to be a greater amount of production that farmers are able to produce.

The seed variable has a significance value of 0.016 (α≤0.05), meaning that this variable partially has a significant influence on potato production in Ngablak District. This is in line with research Juiwati et al. (2018) that seeds have a positive and significant effect on potato productionThe number of seeds used by the respondent farmers in the study area met the recommended average standard for using seeds, namely 1.472.55 kg/ha and is a certified seed.

Table 2. Regression Test Results Effect of Production Factors on Potato Production

Variable	Koef	t Count	Sig
Constant	5,511	3,939	0.000
Land Area (X1)	0.490	2,380	0.020
Seeds (X2)	0.294	2,456	0.016
Organic Fertilizer (X3)	0.137	1.229	0.223
Phonska Fertilizer (X4)	-0.001	-0.007	0.995
Pesticides (X4)	0.053	2,611	0.011
Labor (X6)	0.069	2,038	0.045
F_{count}= 34,249			0.000
F_{table}= 2.13			

Source: Primary Data, 2022

Sarjan (2021) revealed that using the right dosage, quality and certified potato seeds can increase potato production because they tend to be resistant to pests and diseases and have high production characteristics. The organic fertilizer variable partially has no effectsignificantly to potato production. This can be seen from the sig value of 0.233 > α 0.05 and t count = 1.229 <t table = 1.999. The insignificant effect of organic fertilizer on potato production is supported by research conducted by Rizkiyah et al. (2014) that organic fertilizers do not have a significant effect on potato production in Sumber Brantas Village, Batu City with a significance value of 0.067.Organic fertilizer used by farmers in the study areanot effective because it uses organic fertilizerscongested,therefore it needs to be supported by the use of poopliquid organic uk.According to Karamina (2016)solid organic fertilizer added with liquid organic fertilizerwill provide an opportunity to increase production because liquid organic fertilizer can stimulate growthand increase the number of leaves formedthus the process of photosynthesiswill produce more photosynthate to support the process of forming leaves and filling potato tubers.The application of organic fertilizers in the study area did not meet

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the recommended dose of only 21,733.60 kg/ha.Setiawan (2018) emphasized that the ideal dose of organic fertilizer for potato plants is 15-25 tons/ha.

The phonska fertilizer variable partially has no significant effect on the production of potato farming in Ngablak District, it can be seen from the value of t count = -0.007 < t table = 1.999with a significance value of 0.99 5 > α 0.05. This is in line with research conducted by Rulianto et al. (2019) that the variable phonska fertilizer individually has no effect on potato production in Karangreja District.Application of fertilizerPhonska on potato plants is not effective.Tando (2019) states thatExcessive use of chemical fertilizers can cause land degradation such as a decrease in soil organic C which will have an impact on less efficient fertilization that has been done.Jthe amount of phonska fertilizer used was below the recommended dose, which was only 1,067.01 kg/ha.Amin's research (2014) revealed that the best dose for applying Phonska fertilizer for plants is 700-900 kg/ha.

The pesticide variable has a t count of 2.611 > t table = 1.999 with a significance of 0.011 ≤ α 0.05. Based on the results of this analysis, it can be concluded that pesticides have a partially significant effect on potato production in the study area. Fianda et al (2016) stated that the use of pesticides had an effect on the resulting potato production. The regression coefficient shows a positive value, meaning that pesticides have a positive effect on potato production. A positive effect does not always require farmers to increase the dose of pesticides because pest control must be carried out efficiently i.e. disusedfish with plant needs. The use of pesticides according to Juiwati et al. (2018) must be in accordance with plant conditions, the dosage used and the right time can help increase production yields.

The labor variable has a t value of 2.038 and a significance of 0.045. The t count value is 2.038 > t table 1.999 and the significance value is α≤0.05, meaning that this variable partially has a significant influence on potato production in the study area. This is in line with research conducted by Hidayat and Susilowati (2021) that the labor production input used in potato farming partially has a significant effect on potato production. Respondent farmers in the study area have an average age offall into the productive age category, namely 15-64 years. Princess et al. (2021) expressed the opinion that farmers who are of productive age are generally more motivated in developing potato farming and can accept new technological innovations so as to increase the productivity of the farming.

Technical Efficiency Analysis

Technical efficiency is used to measure a farmer's ability to obtain maximum output by using a combination of inputs. The achievement of technical efficiency of potato farming in the study area can be seen in Table 3. The average value of technical efficiency of potato farming in the study area is 0.72, meaning that potato farming carried out by farmers in Ngablak District is in the inefficient category. This is supported by statements Asmara et al. (2022) that potato farmers in the Bromo highlands have not achieved technical efficiency with an average technical efficiency value of 0.77.Farmers in the penel areaitian has a low level of education.Farmer with tLow education levels generally do not like innovation so that the mental attitude to increase knowledge, especially agricultural science, is lacking

The one sample t test was carried out forcompare the average value of technical efficiency with a technical value of one (test score = 1). A significance value of 0.000 <0.05 indicates that the technical efficiency of potato farming in Ngablak District is different from the technical value of 1 at

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a 95% confidence level, so it can be concluded that potato farming in Ngablak District is not technically efficient.

Table 3. Description of Achievement of Technical Efficiency of Potato Farming in Ngablak District

No	Information	Percentage (%)
1	TE maximum	0.41
2	Minimum TE	0.90
3	TE average	0.72

Source: Primary Data, 2022

Economic Efficiency Analysis

Economic efficiency is a condition that states the production process has reached maximum profit. Optimal input use is when the value of NPMx and Px = 1. The results of the analysis of economic efficiency at the research location can be seen in Table 4. Land area has an economic efficiency value of 2.47 > 1 meansvariable land area is not economically efficient. The NPMx value of land area production inputs is greater than the input price (Px). This illustrates that the land area production input still has benefits so it needs to be added. The average area of potato farmers' land in the study area is 0.26 ha.Additions can be made by expanding the potato planting area.According toHartono (2018) minimum land area that is efficiently used in potato farming is 0.6Ha.Land is a factor of production that has a major role in farming activities. Suharyanto et al. (2015) stated that land area is a production factor that has a major contribution to increasing production because it affects the scale of farming that is run.

The economic efficiency value of the seed variable is 1.75 > 1, which means that the use of seed production factors has not reached economic efficiency. Achievement of economic efficiency can be pursued by adding seed production inputs. This is supported by research conducted by Sholeh et al. (2013) which states that seed production inputs have not achieved economic efficiency. Kiromah (2021) added that the relatively high price of seeds is thought to be the cause of the inefficient use of production inputs. The average price of potato seeds used by farmers in the study area is Rp. 20,000/kgwith the ideal price of potato seeds between Rp. 9,000-Rp. 12,000/kgso thatin this casefarmerusing minimal seed input to reduce production costs.

The economic efficiency value of organic fertilizer is 2.21, meaning that the economic efficiency value is more than 1 so it can be concluded that the use of organic fertilizer production inputs is not economically efficient. The value of economic efficiency > 1 illustrates that the use of these inputs still has benefits. The use of organic fertilizers in the research area on potato farming is lower than the recommended dose, which is only 21,733.60 kg/ha. Economic efficiency of organic fertilizerscan be reached withincrease in the use of the production input. According to Shiddiq (2020) the use of organic fertilizers should be adjusted to the needs of plants.

The economic efficiency value of the Phonska fertilizer variable is -0.07 < 1, meaning that the use of production inputs is already in the optimal stage, namely 1,067.01 kg/ha. This economic efficiency can be achieved by reducing the use of Phonska fertilizer. Research conducted by Quraisyin et al. (2020) showed that the application of phonska fertilizer at a dose of 400 kg/ha had a significant effect and showed the best plant growth on the granola potato variety. The economic efficiency value of the pesticide variable is 1.18. This means that the value of economic efficiency is

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> 1, so it is necessary to increase the use of pesticides. This is in accordance with Lilis' statement (2018) which states that if the value of economic efficiency is more than 1, it means that the use of production inputs is not optimal and needs to be added.

The economic efficiency value of the workforce is 0.67 < 1, meaning that the use of labor is not economically efficient so that reductions are made. The use of labor in the research area is 335.69 hkp/ha. Reducing labor can be done during plant maintenance and can be done by using labor in the family. Labor during land preparation and harvesting can also be reduced by using machine tools in the form of tractors and potato harvester machines. Kusumadewi (2021) argues that proper management of production factors can reduce production costs thereby increasing the production of these farms. Based on the results of the one sample t test analysis in Table 5, it can be seen that the significance value for each production input is land area, seeds, organic fertilizer, phonska fertilizer, pesticides, and labor, which is 0.000. A significance value of 0.000 <0.05 indicates that there is a difference between the value of economic efficiency and predetermined criteria. This means that the use of production inputs in the form of land area, seeds, organic fertilizers, phonska fertilizers, pesticides and labor is not economically efficient.

Table 4. Calculation of Economic Efficiency of Potato Farming

Production Factors	Xi	Mrs	NPMxi	xi	Economic Efficiency
Land area	0.26	0.939	140,881,708	30,000,000	2.47
Seeds	386,2	0.647	80,992	20,000	1.75
Organic fertilizer	5700,0	-0.398	-3,127.8	500	2,21
Phonska fertilizer	279.8	0.196	33,761.7	2,500	-0.07
Pesticide	9.55	0.416	1,849,044.2	198,000	1.18
Labor	88.04	0.202	97,188.3	50,000	0.67
Production (Y)	4576				
Potato Prices (PY)	9000				

Source: Primary Data, 2022

Table 5. Test results One Sample t Test Each Production Input of Potato Farming

Production Factors	Std Error Mean	Sig.
Land area	0.11810	0.000
Seeds	0.09778	0.000
Organic fertilizer	0.14105	0.000
Phonska fertilizer	0.00524	0.000
Pesticide	0.06147	0.000
Labor	0.05067	0.000

Source: Primary Data, 2022

CONCLUSION AND SUGGESTION

The conclusion from this research are:

1. Potato production in the study area was influenced by seed area, pesticides and labor factors, while the production factors of organic fertilizer and phonska fertilizer had no significant effect on potato production.

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2. Potato farming in Ngablak District has not yet achieved technical efficiency. The average technical efficiency value obtained is 0.72 or 72%.
3. Use of land area production inputs, seeds, organic fertilizers. And pesticides are not yet economically efficient. The addition of production inputs needs to be done in order to achieve maximum profit. The use of production inputs for phonska fertilizer and labor is not economically efficient, so the use of these production inputs needs to be reduced.

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