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Yang bertanda tangan dibawah ini :

Nama : Suwali, S.P., M.Si.

Jabatan : Ketua Lembaga Penelitian dan Pengabdian Kepada Masyarakat
Universitas Perwira Purbalingga

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No	Nama	NIDN	Prodi	Status
1	Ayu Sitanini, S.E., M.P.	0603018702	Agribisnis Universitas Perwira Purbalingga	Dosen Tetap
2	Victor Bintang Panunggul, S.P., M.P.	0621039202	Agribisnis Universitas Perwira Purbalingga	Dosen Tetap
3	Dwi Kurniawati	02003029	Agribisnis Universitas Perwira Purbalingga	Mahasiswa
4	Raflina Nurwanda Ningsih	02003036	Agribisnis Universitas Perwira Purbalingga	Mahasiswa

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EFFICIENCY OF PRODUCTION FACTORS USAGE IN ENVIRONMENTALLY CONSCIOUS POTATO FARMING IN KARANGREJA DISTRICT, PURBALINGGA REGENCY

Ayu Sitanini^{1*}, Victor Bintang Panunggul¹, Dwi Kurniawati¹, Raflina Nurwanda Ningsih¹

¹Department Agribusiness, Faculty of Science and Engineering, Perwira Purbalingga University

Corresponding author : ayusitanini@gmail.com

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ABSTRACT

The main problem in potato farming is the problem of efficient use of production factors. Efficient use of production factors will determine the size of profits. National-level potato productivity is decreasing from year to year. National-level potato productivity in 2023 will be 19.27 tons/ha. Potato productivity in Karangreja District is 14,715 tonnes/ha, below the national average. The research aimed to describe the environmental conditions in the area due to potato crops and analyze the influence of product factors on productivity and price/allocative efficiency in potato farming in Karangreja District, Purbalingga Regency. The research method used is a survey, which uses simple cluster sampling. The analysis method uses financial analysis methods, and multiple linear regression analysis (Cobb Douglas production function). Seeds, manure, organic fertilizers, pesticides, and the area of land used cannot be increased to increase product per unit area. Physically, the workforce used can still be increased to improve the product. At the price level of potato products of IDR 8,000 and labor wages of IDR 40,000, the use of labor in potato farming in Karangreja District already provides maximum profits

Keywords: Efficiency; Farming; Environmentally Minded

ABSTRAK

Permasalahan utama pada usahatani kentang adalah masalah efisiensi penggunaan faktor produksi. Penggunaan faktor produksi yang efisien akan menentukan besarnya keuntungan. Produktivitas kentang tingkat nasional dari tahun ketahun semakin menurun. Produktivitas kentang tingkat nasional tahun 2023 sebesar 19,27 ton/ha. Produktivitas kentang di Kecamatan Karangreja sebesar 14,715 ton/ha, di bawah rata-rata nasional. Tujuan penelitian adalah untuk menggambarkan kondisi lingkungan di daerah penelitian akibat tanaman kentang dan menganalisis pengaruh faktor produk terhadap produktivitas, dan efisiensi harga/alokatip pada usahatani kentang di Kecamatan Karangreja Kabupaten Purbalingga. Metode penelitian yang digunakan adalah metode survei, metode pengambilan sampel menggunakan simple cluster sampling. Metode analisis menggunakan metode analisis finansial, analisis regresi liner berganda (fungsi produksi Cobb Douglas). Benih, pupuk kandang, pupuk organik, pestisida dan luas lahan penggunaannya sudah tidak dapat ditingkatkan, untuk meningkatkan produk persatuan luas. Secara fisik tenaga kerja penggunaannya masih dapat ditingkatkan untuk meningkatkan produk. Pada tingkat harga produk kentang sebesar Rp8.000 dan upah tenaga kerja sebesar Rp40.000,- penggunaan tenaga pada usahatani kentang di Kecamatan Karangreja sudah memberikan keuntungan maksimum.

Kata kunci: Efisiensi; Usahatani ; Berwawasan Lingkungan

INTRODUCTION

One potato-producing area in Central Java is Karangreja District, located at the foot of Mount Slamet at 790 meters above sea level. Most farmers who have land at these heights are engaged in farming. The natural conditions are suitable for growing potato plants so that they can be a source of income for the community to meet their needs and maintain their survival.

The problems of farming annual crops on dry, sloping land are very diverse, so if they are managed well, they will maintain the balance of the environment. These disturbances include (a) soil and water erosion, (b) decreasing land fertility levels, (c) decrease in land productivity, (d) the occurrence of natural disasters such as floods and landslides, (e) shallowing of the river, which results in the useful life of the reservoir being reduced (Kusmanto, 2010).

One of the leading national vegetable commodities the government prioritizes for development is potatoes (*Solanum tuberosum* L). Potatoes are a popular commodity that is easy to develop into various preparations, including chips, potato *chips*, starch, flour, *French fries*, and other preparations that can increase farmers'

income. The growth in domestic consumption with a population of around 270 million has resulted in vast open market opportunities, meaning that the availability of potatoes must always be guaranteed, opening up opportunities for expanding potato production (Anggraeni, 2015).

The large Number of regions that are potato production centers makes it possible to develop highland potato cultivation and production in Indonesia (Desy *et al.*, 2021). According to the Central Statistics Agency (2020), 22.8% of national potato production comes from Central Java. In 2020, potato production was 293,936 tons and ranked second after East Java, contributing 23.77%. Previous research results have not discussed much about the impact of excessive use of pesticides. So, the contribution of the research results includes the impact of excessive use of pesticides, causing acute respiratory infections in farmers. The results of research by Rosmawati (2015) show that the decline in potato production in Bengkulu province esp, especially in the research area, is caused by several factors, namely farmers switching to planting other commodities, namely coffee, which is considered more profitable and planting potatoes

requires relatively high capital and the risk of failure is also high. Large enough, farmers are generally less interested in planting potatoes. Rahmah and Wulandari (2021) stated that the income from potato farming was IDR. 133,634,318 per hectare with a total cost of Rp. Ninety-eight million eighty-two thousand six hundred eighty-six per hectare, and the income received was IDR. 35,551,632 per hectare. The results of the farming feasibility analysis obtained an R/C value of 1.36, which shows that potato farming is worth running.

This research aims to describe the environmental conditions in the research area due to potato crops and analyze the influence of product factors on productivity and price efficiency/allocation in potato farming in Karangreja District, Purbalingga Regency. One potato-producing area in Central Java is Karangreja District, located at the foot of Mount Slamet at 790 meters above sea level. Most farmers who have land at these heights are engaged in farming. The natural conditions are suitable for growing potato plants so that they can be a source of income for the community to meet their needs and maintain their survival.

The problems of farming annual crops on dry, sloping land are very diverse, so if they are managed well, they will maintain the balance of the environment. These disturbances include (a) soil and water erosion, (b) decreasing land fertility levels, (c) decrease in land productivity, (d) the occurrence of natural disasters such as floods and landslides, (e) shallowing of the river, which results in the useful life of the reservoir being reduced (Kusmantoro, 2010).

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RESEARCH METHODS

The research was carried out on April 2023 in Karangreja, Purbalingga Regency, Central Java. Purposively due to considerable as center potatoes in the District Purbalingga.

The sampling method used a simple cluster sampling, which is a method where the population studied is divided into groups, and these groups become sample units (samples) studied. The Number of sample farmers is calculated based on the following formula:

$$n = \frac{N \sum N_h \cdot sh^2}{\frac{N^2 \cdot d^2}{z^2} + \sum N_h \cdot sh^2}$$

The Number of sample farmers in each stratum is calculated using the following formula

$$nh = \frac{Nh.n}{N}$$

$$sh^2 = \frac{\sum (Xi - \bar{X})^2}{n-1}$$

Notification:

- n = Number of sample farmers
- nh = Number of sample farmers in each stratum
- N = Number of Population
- Nh = Number of elementary units in each stratum
- sh = Standard deviation of the hth stratum
- z = normal variable (2)
- Xi = potato production per hectare

Types and Techniques of Data Collection

Data collection techniques for research purposes were carried out in three ways, namely: interviews using a list of questions that had been prepared in advance, recording, namely recording secondary data sourced from Service Offices or Institutions related to this research and observation, namely directly observing potato farming activities at the location. Study.

Analysis Method

Estimation of estimated parameters using the Cobb-Douglas production function:

$$\ln Y = \alpha_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6$$

Notification:

- Y = potato productivity (kg)
- X1 = seeds (kg)
- X2 = labor (HOK)
- X3 = manure (kg)
- X4 = inorganic fertilizer (kg)

- X5 = farmer education (years)
- X6 = farmer's age (years)
- X7 = farming experience (years)
- A = intercept
- $\beta_1, \beta_2, \dots, \dots$ = regression coefficient

The analysis model uses the coefficient of determination (R^2), F test (*overall test*), and t-test (*individual test*), namely:

(b) The next test is to test whether the independent variables together affect the dependent variable using the F test, with the following hypothesis formulation:

$$H_0: \alpha_1, \dots, \alpha_8; \beta_1, \dots, \beta_3; d_1, \dots, d_i = 0$$

$$H_a: \text{at least one of } \alpha_i, \beta_i, \neq 0$$

$$F_{hitung} = \frac{R^2 / (k-1)}{(1-R^2) / (n-k)}$$

Notification:

- R^2 = coefficient of determination
- k = Number of independent variables
- n = Number of samples

The testing criteria are as follows:

"If the calculated F is greater than the F table ($\alpha\%$, nk-1), then the null hypothesis (H_0) is rejected. This means that the independent variables together statistically significantly affect the dependent variable.

Meanwhile, to find out whether individual independent variables statistically have a natural effect on the dependent variable, a t-test is carried out with the following hypothesis formulation:

Ho: $\alpha_i, \beta_i = 0$ and $H_1: \alpha_i, \beta_i \neq 0$

Information:

R^2 = coefficient of determination

k = Number of independent variables

n = Number of samples

The testing criteria are as follows:

"If F_{count} is greater than F_{table} ($\alpha\%$, $n-k-1$), then the null hypothesis (H_0) is rejected. This means that the independent variables statistically significantly affect the dependent variable together.

Meanwhile, to find out whether individual independent variables statistically have a natural effect on the dependent variable, a t-test is carried out with the following hypothesis formulation:

Ho: $\alpha_i, \beta_i = 0$ and $H_1: \alpha_i, \beta_i \neq 0$

$$t_{hitung} = \frac{\alpha_i; \beta_i}{S\alpha_i, Sb_i}$$

Information:

α_i, β_i = estimated regression coefficients

$S\alpha_i, Sb_i$ = standard error of the estimated regression coefficient

If the $t_{critical}$ is higher than t_{table} ($0,5\alpha\%, n-k$), then H_0 is not accepted, meaning that the independent variable statistically has a significant effect on the dependent variable.

Then, test classical assumptions: normality test, multicollinearity test,

and heteroscedasticity test to see whether the confounding variables from all observations have the same/constant variance. The method used to detect heteroscedasticity is the White method.

Allocative efficiency (price) will be achieved if the marginal product value of a production factor (MPV_{xi}) is equal to the Marginal Victim Cost (BKM_{xi}), which is expressed in the formula:

MPV_{xi}

If $MPV_{xi} < 1$, then the use of production factors is inefficient

If $MPV_{xi} = 1$, then the use of production factors is efficient

If $MPV_{xi} > 1$, then the use of production factors is not efficient

RESULT AND DISCUSSION

Respondent Profile

The Number of respondents was 39 potato farmers. The average farmer's land ownership is 0.18 ha. Based on age data, most respondents are still of productive age (92%). The highest education level of respondents was elementary school at 66% and secondary school at 34%. The average Number of respondents' family members is three people, the highest is five people, the lowest is two people, and the average Number of respondents' family dependents is three.

In potato farming, farming costs incurred by farmers vary according to the area of potato cultivation land. Farming costs consist of fixed costs and variable costs. Fixed costs include land rental costs, hand sprayer rental, land

tax, and equipment depreciation. Variable costs include purchasing inputs such as seeds, inorganic fertilizers, pesticides, and labor. Details of costs and ncome can be seen in Table 1.

Table 1. The results of productivity calculations from potato farming in Karangreja

No	Variable	Highest	Lowest	Average
1	Seed (kg)	2,500	769	1,458
2	Labor (H OK)	480	401	473
3	Manure (kg)	50,000	5000	10,000
4	manure (kg)	7,692	260	2,459
5	Pesticide (Rp)	2,961,538	12,000	2,081,714
6	Productivity kg/ha	18,000	10,143	14,715

Source: Sitanini *et al.* (2023)

Potato farmers use only one variety of potato seeds: granola or vegetable potatoes. Most farmers use their own harvested potato seeds and their offspring because the price of seeds from breeders is high and limited. Several farmers buy G3 seeds from breeders and cultivate them up to G5. Potato seeds used by farmers are generally medium-sized seeds (S) containing approximately ± 20 knol/kg, which are called the DN class category. The average amount of potato seeds farmers use for potato farming is 1,458/ha.

Potato average product produced by potato farmers is 14,715 kg/ha. There are three types of sizes of potato products produced by farmers,

namely large potatoes called class AB (6-8 knol/kg), class N (16-20 knol/kg), and class Rindil (30-40 knol/kg). The price of potatoes depends on their size; class AB is the most expensive.

Most of the workers used for potato farming come from outside the family, and a small number come from farming families. The workforce consists of female and male workers. Women's labor is used for planting, repairing bunds, and repairing plastic mulch (for those who use mulch). The average Number of workers used by farmers is 401 MWD.

Farmers use various types of inorganic fertilizers, and their composition varies. There are five types of fertilizer used by farmers, namely

Urea, SP36, KCl, NPK, and Phonska. Some farmers use a mixture of Urea + KCl + Phonska. Some use Urea + Phonska or SP36 + Urea + Phoskha, and some only use Urea due to cost issues.

Potato farmers generally use organic fertilizer in the form of manure, namely chicken manure (chicken feces), which is ready to be used as fertilizer. These chicken droppings cause environmental impacts in the form of odors and flies. Manure in the form of manure, before use, is often placed on the side of the road, causing a powerful odor. Moreover, manure waste will be carried by water flowing in all directions during the rainy season. The environmental impact of manure causes crowds of flies, so houses around potato gardens have lots of flies. The average manure used for potato farming is 10,000 kg/ha.

Potato farming uses quite a lot of pesticides to maintain plant life. Potato plants originate from sub-tropical climates. Indonesia is a country in the tropical region, so the potato plant has many problems, starting from high rainfall and pest plant organisms. At the beginning of their growth, potato plants are very vulnerable to rainfall, so if it rains, farmers will spray the potato plants with pesticides. Kusmantoro *et*

al.(2009) show that the use of pesticides in potato farming does not consider the economic threshold value. The method they use is a scheduled spraying method. There are "blank 3" (meaning pesticide spraying is done every two days), "blank 4" (meaning pesticide spraying is done once every three days), and "blank 5" (meaning pesticide spraying is done once every four days). Many pesticide *brands are* used, namely 47 pesticide *brands* consisting of insecticides and fungicides. In general, spraying is done by mixing insecticide and fungicide, although often neither is needed.

Potato farming costs in Karangreja District include fixed costs and variable costs. Fixed costs in research include land rental costs and land taxes. Farmers pay an average of IDR 1,273,809 for renting land for potato farming. The average cost of using potato seeds per hectare is IDR 30,362,379, pesticides are IDR 2,081,714, organic fertilizers are IDR 8,660,872, inorganic fertilizers are IDR 2,081,214 and average labor costs are IDR 9,194,297. The total costs incurred by farmers for potato farming are IDR 53,156,844/ha, while the income obtained by farmers is an average of IDR 137,907,378.13. So, farmers' profit

from potato farming in Karangreja District is IDR 84,750,533.69.

Production

Function Analysis

The production function is a technical relationship between the independent and dependent

variables, drawn in the form $Y = f(X)$. Factors that influence potato production are seed, manure, organic fertilizer, pesticides, and labor. The production function used Cobb-Douglass Production Function, as seen in Table 2.

Tabel 2. Analysis Multiple Linear Regression *Input* dan *Output* on Potato Crop Farming

Variable	Coefisien	Std. Error	t-Statistic	Probability
C	1,1195	3,3642	0,3327	0,3327
Seed	0,1100	0,1592	0,6911	0,4944
Land	-0,1121	0,4070	0,2754	0,7847
Pesticide	0,0065	0,1232	0,5398	0,5930
Anorganic Fertilizer	-0,0392	0,0814	0,4821	0,6330
Organic Fertilizer	0,1842	0,1427	0,2907	0,2060
Labor	0,8794	0,4092	2,1487	0,0393
R ²	0,7465			
F-statistic	15,7060			0,0000

Resources: Primary data Analysis, 2023

There is only one variety of potato seed farmers use for organic rice farming in Karangreja District, Purbalingga Regency, namely the granola variety, and some still need to be certified. Adding or subtracting seeds does not increase or decrease the potato product. Potato seeds have no natural effect on potatoes because the seeds used by farmers come from G3, which has low productivity. This result was different from research by Edison et al. (2004), which states that seeds play a dominant role in increasing potato production.

The pesticide regression coefficient does not significantly affect

the product, meaning that additional use of pesticides in potato farming cannot increase or decrease potato production. Farmers who use pesticides no longer pay attention to the economic threshold value. The amount of costs incurred shows that the use of pesticides has exceeded the capacity needed to control organisms. Pesticide spraying is no longer based on attacks by pest organisms but is already scheduled at the start of cultivation. For example, farmers plan to spray once every five days, with the term empty five or empty 3 (every three days). This situation is supported by research by Gultom (2018), who found that various

pesticides have exceeded optimal levels because the MPV/P_x value is smaller than 1.

Using organic fertilizer does not affect increasing or decreasing potato production. The average amount of organic fertilizer farmers reached 10,000 kg/ha. Organic fertilizer can improve the physical, chemical, and biological soil by gradually releasing nutrients into the soil water solution to plant, maintain and help regulate temperature and humidity, increase the amount, and increase biological activity and stability of land capabilities (Sufianto, 2013). From this explanation, the use of organic fertilizer needs to be improved.

Inorganic fertilizers used by farmers in Karangareja include Urea, Phonska, KCl, and Sp36. Organic fertilizer did not affect the product, meaning each addition will not increase or decrease potato production. This

result differs from research by Agatha and Wulandari (2018), stating that the regression coefficient for chemical fertilizers is -0.323 and is significant. This value showed that % increase in chemical fertilizers by 1% will reduce production by 32.3%, which means that the more chemical fertilizers used, the more there is a tendency to reduce output.

Efficiency of Production Factors Usage

Efficiency of Production Factors Usage is often called price or allocative efficiency. Analysis of the efficient use of production factors is used to determine whether the use of production factors in a farming business is efficient or not/inefficient. Price efficiency analysis is only used for inputs that directly affect output. The results of the price efficiency analysis of input use in potato farming are presented in Table 3.

Tabel 3. Input Utility Efficiency on Potato Crops Farming

Variable	Input price	Marginal Product Value (MPV_{xi})	$(MPV_{xi})/ P_x$
Labor	40.000	105.948.000	211.896

Resources: Primary data Analysis, 2023

The labor use efficiency analysis results 211,869 are greater than one and significant at the 95% confidence level. This condition shows that the use of labor is efficient. This value showed that

farmers can manage the use of labor according to their needs. Efficient use of labor means that the use of labor provides maximum profits for potato farming. In contrast, research by Deras

and Sinulingga (2021) shows that using labor could be more efficient. The use of labor in the research area differs from the recommended amount, namely 416.08 MWD/ha.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded:

1. Seeds, manure, organic fertilizers, pesticides and the area of land used cannot be increased to increase product per unit area. Physically, the workforce can still be used to improve the product.
2. At the price level of potato products of Rp. 8,000 and labor wages of Rp. 40,000,- the use of labor in potato farming in Karangreja District is already profitable.

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