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PRODUCTION FACTOR PERFORMANCE AND ALLOCATIVE EFFICIENCY ARABICA COFFEE FARMING IN KAYUMAS VILLAGE

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ABSTRACT

Coffee is one of the plantation commodities that has an essential role in Indonesia's economic activities. Kayumas Village, Arjasa District, Situbondo Regency, is the area that grows the most Arabica coffee compared to other areas in Situbondo Regency. The decline in selling prices and demand for coffee is one of the existing problems, so it is necessary to use coffee production factors efficiently so that farmers can still get maximum profits. This research aims to identify factors that influence Arabica coffee production and the allocative efficiency of Arabica coffee farming. Secondary and primary data collected through interviews and observations were analyzed using the Cobb-Douglas method and the allocative efficiency formula. The number of respondents was 20 people in the Sejahtera farmer group in Kayumas Village, Arjasa District. Determining respondents used a saturated sampling technique because there were fewer sample farmers than 30 people. The results of this research show that the production factors are land area (X_1), number of coffee trees (X_2), labor (X_3), organic fertilizer (X_4), age of coffee plants (X_5), distance from house to land (X_6), and shade plants. (X_7) simultaneously influences coffee production. However, partially, the production factors that influence coffee production include land area (X_1), age of the coffee plant (X_5), and distance from house to land (X_6), with a significance of less than 0.05. The level of allocative efficiency of the production factors of land area and organic fertilizer is still not efficient, while the production factors of labor and the number of trees are not yet efficient, so to achieve this level of efficiency, the input in the form of labor and the number of trees must be reduced. This differs from the land area and organic fertilizer that farmers need to increase to reach an efficient level in Arabica coffee production.

Keywords: allocative efficiency; arabica coffee; cobb-douglas; production factors.

INTRODUCTION

Coffee is one of the plantation products that has an essential role in Indonesia's economic activities. East Java BPS data shows that Situbondo Regency is among the places that produce the most coffee, with coffee production in 2022 reaching 795 tons. Arabica and Robusta coffee are the two varieties grown in Situbondo Regency and are spread across four sub-districts: Arjasa District, Sumbermalang District, Mlandingan District, and Jatibanteng District. Unlike robusta coffee, arabica coffee is the most widely planted variety.

Compared to other areas in Situbondo Regency, arabica coffee is most widely grown in Kayumas Village in Arjasa Subdistrict. The coffee farming business faces problems such as small business scale and limited capital. If the business is run simply with limited technology, it will not be easy to grow, especially when competing with farmers with significant capital and access to larger areas. In addition, the COVID-19 outbreak in 2019-2021 impacted the coffee industry. Demand for coffee beans decreased as many coffee shops or cafés had no visitors and closed down. Coffee farmers in Kayumas Village complained about a 50% drop in selling prices. With the decline in selling prices and demand, coffee farmers must continue to use production variables efficiently to maximize income. However, coffee farmers cannot control the production factors that need to be applied to get maximum production results.

According to Dewi *et al*. (2012), farmers must use production components effectively and efficiently to run a sustainable farm. Farmers must pay close attention to production efficiency. It seems that extensification activities will be increasingly difficult to do to increase crop production. The scarcity of productive agricultural land and the diversion of land from agriculture to non-agriculture are problems that are difficult to stem. One of the best options is to improve production efficiency to increase food crop yields. Farmers can achieve optimal output by optimizing agricultural inputs based on needs through efficiency. Mufriantie and Feriady (2014) state that although farmers usually have a limited number of production factors, they still want to increase their farm production. As a result, farmers must use their production factors effectively when managing their farms. If the value of the marginal product and the price of production factors are equal, the use of production factors is considered allocatively efficient (Arta *et al*., 2014).

Coffee farmers in Kayumas Village, Arjasa Sub-district, and Situbondo Regency often face problems using farm production facilities, such as fertilizers, pesticides, and labor. One of their main problems is that they do not have sufficient capital to purchase these inputs because they do not have much-accumulated farming capital. Farmers often use inputs that are not ideal, leading to inadequate maintenance. Nonetheless, proper and effective use of inputs or factors of production will benefit farmers. Farmers in Kayumas Village, Arjasa District, and Situbondo Regency can achieve allocative efficiency if they know the production factors that affect their coffee farming.(Maxiselly et al., 2023)Farmers get many benefits from smallholder coffee. Product diversification will ensure that producers' coffee prices are stable. So, the prosperous farmer group in Kayumas Village, Arjasa Subdistrict, processes coffee beans into powder with an attractive taste for customers.

Isyariansyah *et al*. (2018) examined coffee production factors using labor, land area, number of trees, manure, and NPK. Land area, number of productive trees, urea, ZA, SP36, KCl, pesticides, herbicides, manure, and labor are production factors used by Thamrin (2014). However, Risandewi (2013) used land area, number of workers, coffee plants, fertilizer, and age of coffee plants. In this research proposal, there are some updated variables. These include land area, number of trees, age of coffee plants, labour and fertilizer use, as well as the distance between farmer households and land and shade plants.

Considering this description and supported by the development potential of Situbondo Regency, research is needed on the factors affecting coffee production and the efficiency of production factors in Kayumas Village, Arjasa Subdistrict, Situbondo Regency. This study aimed to find the production factors and allocation efficiency of arabica coffee farming in Kayumas Village, Arjasa Subdistrict, Situbondo Regency.

MATERIALS AND METHODS

This study was conducted from August to September 2023. This research used a descriptive quantitative approach. Numbers and statistical programs were used to answer data research problems. The research site selection used purposive sampling because Kayumas Village is located in the Arjasa Sub-district of Situbondo Regency, the center of Arabica coffee production in Situbondo Regency. Since the number of farmers involved in the sample was less than 30 people and there were 20 farmers in the prosperous farmer group, a saturated sample technique was used to sample 20 coffee farmers in Kayumas Village. Primary and secondary data were used in this study. Primary data was obtained through direct observation at the research site, interviews with respondent farmers, and questionnaires from the Situbondo Agriculture and Food Security Office and BPS.

To solve the first problem, the Cobb-Douglas production function model data analysis method was used.

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$$LnY=\alpha + Lnb_0+ b_1LnX_1+b_2LnX_2+b_3LnX_3+ b_4LnX_4+b_5LnX_5+ b_6LnX_6+ b_7LnX_7+e \quad (1)$$

Information: Y is production (Kg); X_1 is land area (Ha); X_2 is number of trees (units); X_3 is labor (people); X_4 is organic fertilizer (kg); X_5 is coffee plant age (years); X_6 is farmer household distance to land (minutes); and X_7 is shade crops (units). While α indicates Constant, *b* indicates regression coefficient, and *e* indicates tolerance inactivity/epsilon.

Furthermore, it is completed with several tests, including R test^2 (coefficient of determination), f test (simultaneously), and t-test (partially). The R test^2 is carried out to determine how much influence the independent variable has on the dependent variable. The f-test is used to assess the effect of the independent variables on the dependent variable with the criteria. If the value of $f_{(count)} > f_{(table)}$, then the independent variables together have a real influence on the dependent variable. The t-test is conducted to determine how each independent variable affects the dependent variable. The independent variable has a natural effect on the dependent variable if the value of $t_{(count)} > t_{(table)}$.

The formula calculates the second issue of price efficiency or allocative efficiency:

$$EH = NPMx \quad (2)$$
$$bi = dy/dx.\ x/y = PM/PR \quad (3)$$
$$PM = bi\ .\ PR = bi\ .\ y/x \quad (4)$$
$$NPM = PM\ .\ Pv \quad (5)$$

Information: EH is the price efficiency level, NPM is the marginal product value, PMx is the marginal input product, Py denotes the product price, and Px denotes the input price. Criteria: If (NPM / Px) > 1, then the use of production factor x must be increased to achieve efficiency. If NPM/Px < 1, production factor x is inefficient, so a reduction in production factor x is required to achieve efficiency. If NPM / Px = 1, then production factor x is efficient.

RESULTS AND DISCUSSION

Respondent Characteristics

Respondents of this study were all members of the Prosperous Farmers Group in Kayumas Village, Arjasa District, totaling 20 farmers. Mr. Alex Siwoyo Dwi Raharjo founded and chaired the Prosperous Farmers Group in 2010. As shown in Table 1, age, level of education, length of farming business, and land area are the characteristics of the respondents.

Table 1. Respondent characteristics

No	Respondent Characteristics	Total	Percentage (%)
1	Age (year)		
	26 - 42	4	20
	43 - 59	8	40
	60 - 78	8	40
2	Education Level		
	Elementary School	13	65
	Junior High School	4	20
	High School	2	10
	Bachelor	1	5
3	Length of Coffee Farming (years)		
	1 - 15	7	35
	16 - 35	9	45
	36 - 50	4	20
4	Land Area (Ha)		
	0 - 3	15	75
	4 - 6	3	15
	7 - 9	2	10

Source: processed from primary data (2023)

Based on Table 1, respondents are at a productive age. The average percentage of respondents' age was at the age of 43-78 years as much as (80%). This data shows that most Arabica coffee farmers in Kayumas Village are at a productive age. Siswanto and Ratnaningsih (2022) suggested that the ideal productive age for employees is between 15 and 64. Likewise, according to Andrianingsih and Asih (2021), people aged 15-64 years are considered productive, and people above 64 years are considered non-productive. Productive farmers can easily use technology and have the power to manage their farms. (Harahap *et al*., 2023).

Education is essential because it allows us to build our knowledge and mindset. In this case, the education in question is formal. Overall, the education level of the surveyed farmers is low, with 13 people (65%) and one person (5%) having a high education or university degree. This shows that most farmers in Kayumas Village have a low level of education. According to Apriani *et al*. (2023)According to Apriani et al. (2020), education is low if the respondent did not go to high school, while high education is categorized if they have graduated from high school and above. Farmers with higher education tend to have more advanced thinking than farmers with low education.

To start the next farming venture, farmers need a long time to farm and accumulate much experience. The results show that the time respondents spend farming varies. Most respondents in Kayumas Village have been farming for more than 15 years. Farmers' decision to start farming and the farming skills inherited from their ancestors influence the length of time farmers farm. Farmers are familiar with farming methods and have experience in farming. This can help farmers make better decisions using the latest innovations and technologies. According to Hermawan *et al*. (2017), business experience shows farmers' ability to run their businesses indirectly. In addition, it will be easier to anticipate farmers' various challenges. (Drakel, 2012).

The natural resource of land has many benefits that fulfill human needs. From the perspective of agricultural economics, land is a fixed and essential component of various agricultural and non-agricultural production types. Land is a commodity with a price, value, and cost depending on the land produced. The demand for commodities produced is primarily due to the amount of land used for production. Most respondents in the prosperous farmer groups were on 0-3 ha of land (74%), and only (10%) had 7-9 ha of land. Land area and total production are positively correlated because land is the main component of agriculture. Of course, this must have a significant impact on agricultural production. According to Mubyarto (1989) and Agatha & Wulandari (2018), one of the components of agricultural production is land. Agricultural production is influenced by the area of land used.

Factors Affecting Arabica Coffee Production

Using the significance test, know or note partially how land area, number of coffee trees, labor, organic fertilizer, age of coffee plants, distance from house to land, and shade plants affect coffee business production. The results of the regression analysis are as follows:

Table 2: Regression coefficient of arabica coffee production variables

Variables	Unstandardized Coefficients		t count	Sig
	B	Std. Error		
Konstansta	9,632	3,147	3,061	0,100
Land Area (X_1)	1,772	0,625	2,834	0,015
Number of coffee trees (X_2)	-0,657	0,458	-1,435	0,177
Labor (X_3)	0,050	0,395	-0,151	0,883
Organic Fertilizer (X_4)	0,294	0,229	1,280	0,225
Coffee plant age (X_5)	0,725	0,229	3,172	0,008
Distance from house to land (X_6)	-0,319	0,126	2,535	0,026
Shade plants (X_7)	-2,119	0,788	-2,690	0,200
Adjusted R Square	0,662			
F count	6,312			0,003

Source: primary data processed (2023)

Based on Table2, the Cobb-Douglas regression analysis model equation used in this study is interpreted to be :

$$Y = 9.632 + 1.772(X_1) - 0.657(X_2) - 0.060(X_3) + 0.294(X_4) + 0.725(X_5) + 0.319(X_6) - 2.119(X_7) \quad (6)$$

Variables that have negative coefficient values are the number of coffee trees, labor, and shade plants. The coefficient value of the number of coffee trees is -0.657,

The number of coffee trees has a coefficient value of -0.657. In other words, every 1% increase in the variable number of coffee trees will reduce production by 0.657%. Labor has a coefficient value of -0.060, meaning that every additional 1% of labor can reduce production by 0.060%. The coefficient value of shade plants is -2.119, which means that every additional 1% of shade plants will reduce production by 2.119%. In comparison, the variables of land area, organic fertilizer, coffee plant age, and distance from house to land have positive coefficient values. The land area has a coefficient value of 1.772, which means that every additional 1% of the land area will increase production by 1.772%. Organic fertilizer has a coefficient value of 0.294, which means that every additional 1% of organic fertilizer will increase production by 0.294%. The age of the coffee plant has a coefficient value of 0.725, which means that for every additional 1% of the age of the coffee plant, production will increase by 0.725%. The coefficient value of the distance from the house to the land is 0.319, which means that for every additional 1% of the distance from the house to the land, the production will increase by 0.319%.

The Determination Test shows that the dependent variable used in the model is the best, and other factors do not influence the independent variable. [2]If the *Adjusted R Square value* = 1, then the independent variable has one hundred percent influence on the value of the dependent variable. The R-value of 0.662 indicates a strong relationship between the independent variables (number of coffee trees, labor, organic fertilizer, age of coffee plants, distance from house to land, and shade plants) and the dependent variable by 66.2%. The remaining 33.8% indicates that the model does not include other variables such as unpredictable natural factors and management factors.

The purpose of simultaneous testing is to determine whether factors such as land area, number of trees, labor, organic fertilizer, age of coffee plant, distance from house to land, and shade crops affect production output. Table 2 shows that the $_{calculated}$ f value is 6.312, while F_{tabel} is 2.91. Therefore, Ho is rejected with a significant level of 0.003 <α (0.05), and the obtained value of F count = 6.312> Ftabel = 2.91, and H_l is accepted. Thus, H0 is rejected, and H1 is accepted. Therefore, the dependent variable, coffee production, is significantly affected by several independent variables. These variables include the number of coffee trees, labor, organic fertilizer, age of coffee plants, distance of house to land, and shade crops.

The effect of the independent (individual) variables partially on the dependent variable (coffee production) is measured through the t-test. In addition, other variables are held constant. By comparing the t-valuable with the $_{t\text{-}count}$, the significance can be calculated. Table 2 shows the results of the partial test (t-test).

Based on Table 2. the t value of the land area variable is 2.834 with a significance of 0.015. So it is known that in this study, t_{count} 2.834> t_{tabel} 2.160 and a significant value of 0.015. This shows that the land area variable partially (individually) significantly affects coffee production in Kayumas Village, Arjasa District. The land area has a positive effect on coffee production. The more land farmers own in Kayumas, the more coffee production will increase. This aligns with research by Putra and Wenagama (2015) and Prasetyo et al. (2023), which state that land area positively affects productivity and that the more land area, the more coffee production will increase.

Table 2. shows that the calculated t-value of the variable number of trees is -1.435 with a significance of 0.177. The value of $_{t\text{-}count\text{-}}$ 1.435 < t_{table} 2.160 with a significance of 0.177. This indicates that coffee production in Kayumas Village, Arjasa Subdistrict, is partially not influenced by the number of trees. Farmers said that they have about 2500 coffee trees per hectare, exceeding the number required by the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 128, which is 1500 - 2000 trees per hectare for technical standards of coffee plant cultivation in line with Thamrin (2014) who found that the variable number of coffee trees partially had no significant effect on coffee production in Enrekang Regency, South Sulawesi.

Based on Table 2. the t value of the labor variable is - 0.049 with a significance of 0.883. Thus, the calculated t_{value} is - 0.049 < t_{table} 2.160, with a significant value of 0.883. This shows that the labor variable partially (individually) has no significant impact on coffee production in Kayumas Village, Arjasa Subdistrict. Labor in Kayumas is only used for harvesting and transporting crops, not increasing production through fertilizer application and pruning. This aligns with research conducted bySudaryati (2004)and Puryantoro & Wardiyanto (2022), who found that labor did not significantly affect production.

Based on Table 2. the t-value for the organic fertilizer variable is 1.280 with a significance of 0.225. table this shows that t count 1.280 < t_{count} 2.160 with a significance value of 0.225. This indicates that coffee production in Kayumas Village, Arjasa Subdistrict, is not significantly influenced by the organic fertilizer variable partially. Farmers there may still use organic fertilizer irregularly and insufficiently, so the effect is not optimal. This follows research conducted by Syahrial et al. (2017), who found that coffee production in Rangsang Pesisir District, Meranti Island Regency, was not significantly influenced by organic fertilizer (manure).

Table 2. shows that the plant age variable has a t-value of 3.172 and a significance level of 0.008. Thus, it is known that the t_{count} in this study is 3.172> t_{tabel} 2.160 with a significance value of 0.008. This shows that the plant age variable partially influences Arabica coffee production in Kayumas Village, Arjasa Subdistrict. In Kayumas Village, coffee plants grown by farmers are, on average, 12 years old. Productive coffee plants are between five and twenty years old, according to research from the Puslitkoka Institute (Indonesian Center for Coffee and Cocoa Studies). This aligns with research by Purba (2018), who found that the yield of Arabica coffee from smallholder plantations in Dairi Regency is strongly influenced by plant age.

Based on Table 2. the t-value for the variable distance of houses to land is 2.532 with a significance level of 0.026. It is known that the t_{count} in this study is 2.532> t_{table} 2.160, with a significant value of 0.026. This shows that, partially, the distance from the house to the land significantly influences the amount of Arabica coffee production in Kayumas Village, Arjasa District.

The interview results show that farmers usually take 20 minutes from their house to their farm on foot. Farmers will have more time to care for their coffee plants if it takes less time to reach their farms. During harvest season, some farmers even build a simple shelter to spend the night in the coffee plantation because the damaged access road is challenging. In addition to looking after their coffee plants, farmers are incentivized to protect their plants from theft. This is consistent with research conducted by Ananda (2009), who found that rice production in Nogosari Subdistrict, Boyolali Regency, was strongly influenced by the distance of farmers' houses to the land.

It is known in this study that the t value is - 2.690> t_{table} 2.160 with a significant value of 0.020. This is based on Table 2. where the t value of the shade crop variable is -2.690 with a significance of 0.020. This shows that Arabica coffee production in Kayumas Village, Arjasa Subdistrict, is influenced by the variable of shade plants partially (individually). The type of shade plant affects the amount of sunlight absorbed by coffee plants and its effect on physiological processes. Therefore, using different shade plants will impact the growth and production of coffee that will be produced, according to (Sobari *et al.* 2012). Farmers in the Kayumas region use jagir trees and gundar trees as shade plants with moderate shade levels. Shade plants are divided into two categories, according to Kudama (2019). According to Kudama (2019), light shade plants (0-40% coverage) and medium shade plants (40-70% coverage). Following the findings of Maxiselly *et al.* (2023), coffee growth is enhanced by using artificial and natural shade to achieve optimal coffee growth.

Allocative Efficiency

Allocative or price efficiency tests how well variable production factors are used in Arabica coffee cultivation in Kayumas Village, Arjasa Sub-district. Marginal Product Value (NPMx) is compared with the price of each input element or production factor utilized (Px) to determine this value. The findings of the study of allocative efficiency of coffee farming in Kayumas Village, Arjasa Subdistrict, Situbondo Regency are as follows:

Table 3. Allocative efficiency value

Variables	(Bi)	Y	Py	X	Px	NPMX	NPMX/ Px	Conclusion
Land area	1,772	6155	15000	3	40000000	54533300	1,3633	Not yet Efficient
Number of trees	-0,657	6155	15000	5535	20000	-10958	-0,5479	Inefficient
Labor	-0,06	6155	15000	5	50000	-1107900	-22,1580	Inefficient
Organic fertilizer	0,294	6155	15000	2332	208	11637	55,9476	Not yet Efficient

Source: Primary data processed (2023)

Inputs in the form of land area and organic fertilizer must be increased in order to reach the efficiency level. Table 3 shows that the variables of land area and organic fertilizer have NPMx/Px > 1, indicating that the use of land area and organic fertilizer production factors is inefficient. Based on the findings of this study, coffee production will become more efficient through increased land area and proper management (Pratamasari & Prajanti 2022; Sumbodo 2020; Suhartono & Widiyanto 2020). Meanwhile, the variables of labor and number of trees have NPMx/Px values < 1, which indicates that the production factors, namely labor and number of trees, are inefficient. Therefore, labor input and the number of trees must be reduced to reach efficiency. According to research by Suhartono and Widiyanto (2020), using labor is inefficient in coffee production in pine forests. Farmers should empower family labor more and reduce the use of outside labor. It is expected that by empowering family labor, expenses will be reduced, and income from coffee plants will increase.

CONCLUSIONS AND SUGGESTIONS

According to the results of research conducted in Kayumas Village, Arjasa Subdistrict, Situbondo Regency, on the performance of production factors and allocative efficiency of coffee farmers, it can be concluded that simultaneously (Test f) all variables affect Arabica coffee production. However, land area, plant age, and distance to land are variables that partially affect Arabica coffee production. The production variables of labor and number of trees have an inefficient level of allocative efficiency, while land area and organic fertilizer have an inefficient level.

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